Vol. 34 JULY, 1940 No. 1
Published in two sections—Part 1

QUARTERLY
OF THE

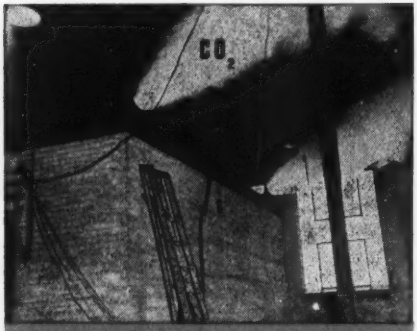
NATIONAL FIRE PROTECTION ASSOCIATION

"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

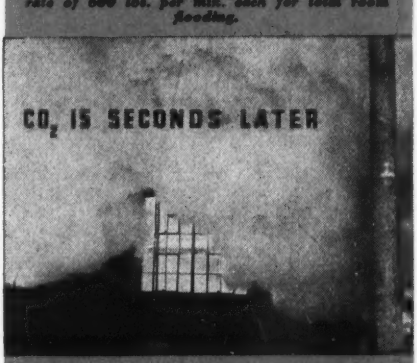
PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

Printed in U. S. A.

Total Room Flooding



CO_2 being discharged from Cardox nozzles at the rate of 600 lbs. per min. each for total room flooding.



The room after 15 seconds of CO_2 discharge. Note how the CO_2 is spreading in all directions.

TESTS REPORTED

Recent tests in an industrial room of 44,000 cu. ft. capacity (data on request) proved the extinguishing action of CO_2 was swift and practical when correctly applied. The room was protected with a permanent Cardox "Low-Pressure" CO_2 Fire Extinguishing System—two nozzles fed through a 2-inch pipe from a low-pressure CO_2 storage tank.

TEST I — *Class B hazard (requiring 50% concentration):* Room flooded in 3 minutes.

TEST II — *Class A hazard (requiring 75% concentration):* Room flooded in 6 minutes. Surface temperature reached 1360 F. and dropped to 155 F. (far below rekindling temperature) during gas discharge.

In each case the fire was completely extinguished before the CO_2 discharge was shut off. The Cardox System is practical for rooms or buildings, regardless of size. *Due to the high rate of discharge — practically unlimited — fewer nozzles are necessary* and therefore a smaller amount of piping is required. Contact Cardox by wire, mail or in person for details on specific applications.

CARDOX CORPORATION

BELL BUILDING, CHICAGO, ILL.

CARDOX

"Low Pressure" CO_2

FIRE EXTINGUISHING SYSTEMS

X

Vol. 34 July, 1940 No. 1

QUARTERLY

OF THE

National Fire Protection Association

Subscriptions to the QUARTERLY are accepted only as a part of the general publications of the Association which are sent to members. Associate membership is open to anyone interested; annual dues $10.

Entered as second-class matter December 15, 1928, at the Post Office at Boston, Mass., under act of March 3, 1879.

60 BATTERYMARCH STREET, BOSTON, MASS.

Application Blank for Associate Membership

Associate Membership is open to any Society, Firm, Corporation or Individual interested in the protection of life and property against loss by fire. Persons in every walk of life are members.

National Fire Protection Association

INTERNATIONAL

Organized 1896

EXECUTIVE OFFICE: 60 BATTERYMARCH STREET, BOSTON, MASSACHUSETTS

All the valuable engineering and popular literature issued by the Association is sent, as issued, to every member.

We furnish free to members the Regulations issued by the National Board of Fire Underwriters, and the lists of devices and materials inspected by Underwriters' Laboratories, Inc.

The Association is the clearing house for all the authoritative information on Fire Protection and Prevention and members are privileged to submit to it their individual problems for solution.

PUBLICATIONS

Quarterly Magazine of the Association. A chronicle of the Association's activities, with valuable contributions of articles on fire prevention and protection and special hazards, and compilations of fire statistics on various classes of property.

News Letter. A special monthly bulletin of timely information on fire prevention and kindred subjects.

Proceedings of Annual Meeting. Containing stenographic report of transactions of the Association and the discussions incident to the adoption of its standards.

Special reports, bulletins, etc., issued frequently during the year.

Year-book and directory. Complete list of members with addresses.

Index to all subjects covered in the Printed Records.

NATIONAL FIRE PROTECTION ASSOCIATION,
60 Batterymarch Street, Boston, Mass.

Please enroll me (or us) as an associate member, and forward the publications to which members elected this month are entitled. I transmit herewith $10.00 as my annual membership dues, which includes a year's subscription to the "Quarterly" of the National Fire Protection Association.

Name.....

Business Connection.....

Street and Number.....

City and State.....

Membership year begins with date of election.

$10 per year dues is the total expense.

No initiation fee, no further assessments.

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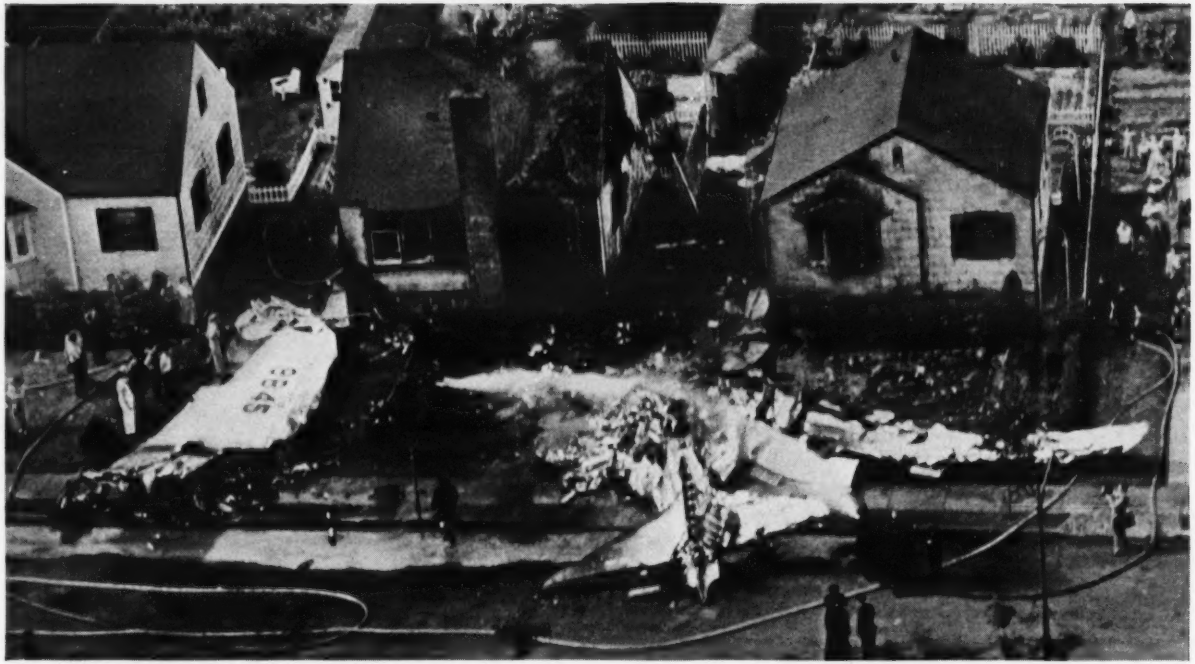
Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.



International.

A mid-air collision and subsequent crash of two Army bombing planes in Queens Borough, New York City, on June 17, is indicative of the unexpected ways in which disaster sometimes visits peaceful residential areas. Eleven Army flyers and a housewife met death. The housewife was trapped in her home as large amounts of burning gasoline from the bombers' fuel tanks ignited seven houses along the two streets in which the planes crashed. Twenty-two fire alarm boxes over a square-mile area were operated by desperate citizens, and countless telephone calls swamped the fire alarm switchboard.

The Quarterly

Vol. 34 July, 1940 No. 1

Fire and War In time of war or intensive preparation for national defense, fire protection is of great importance. When industries producing war materials are operating at top speed, there is every opportunity for fire owing to the neglect of usual precautions under the stress of emergency conditions. Proper fire prevention precautions, adequate fire extinguishing equipment and above all proper organization to deal with fire matters are all of utmost importance in any national defense program.

The opportunity for fire, either accidental or plotted by foreign agents, may be found at every point in the chain of industrial production, storage and shipping. Raw materials of all kinds, as well as finished products, must be considered.

To protect these values and prevent serious interference with the defense program by reason of fires and explosions, accidental and malicious, calls for an effective and coördinated national program for fire safety. In a totalitarian state such matters would be the sole responsibility of the central government, but in a democracy all concerned have opportunity to participate and should coöperate to the best of their ability. It may be taken for granted that in the United States every one concerned will coöperate. Voluntary service will be available without question from insurance men of various groups, fire chiefs, building inspectors and other public officials, manufacturers of equipment, industries concerned and patriotic citizens generally. We have in the United States the will to prevent such fires; we have the technical knowledge as to the methods which should be applied, and we have the available personnel to do an effective job. What is needed is proper coördination, minimizing the overlapping of effort and duplication of work and eliminating the competition and petty jealousies which often occur between people working for a common end, which without some effective coördinating plan may seriously interfere with our national efficiency in dealing with this emergency.

* * * * *

Sabotage With the thoughts of North America turned toward the current defense problem, fires due to sabotage are likely to be of increasing concern. The problem of arson has been with us for years, but has been

kept under control through the activities of fire marshals and other authorities. Now, we have to consider the possibility of a new motive in arson, making this entire subject of even greater importance to all fire authorities. The article in this issue, "Arson in Times of War," by Dr. Richard C. Steinmetz is a thoughtful and constructive contribution on this subject.

A word of caution is perhaps in order. Accidental fires, where proper precautions are not taken, may be expected to continue and are just as destructive in their effects and just as hampering in our defense program as malicious fires due to sabotage. While it is important that in this period particular attention be given to the danger of fires due to sabotage, the usual accidental fire causes must not be overlooked. It is all too easy to attribute any fire to the work of foreign agents and concentrate attention upon apprehending some supposed saboteur in cases where the fire or explosion may actually have been of accidental origin and might have been prevented by ordinary fire prevention precautions. This indicates that added emphasis should in these days be placed upon competent investigation of fires in order to determine their true cause and to take action on the basis of facts rather than supposition. Furthermore, all the standard measures of fire protection should be employed, as the facilities for prompt fire detection, restriction of the spread of fire and extinguishment are equally applicable to both accidental and malicious fires.

* * * * *

New Hazards

We are told that the United States, while largely self-sufficient for defense purposes, lacks an adequate domestic source of supply for some twenty-one basic raw materials. In connection with the defense program, the lack of these materials will naturally result in efforts to develop synthetic or substitute materials to take their place in case foreign supplies are cut off. In the haste of emergency, with all attention centered upon production, there is a danger that any fire and explosion hazards that may be found in connection with such synthetic or substitute materials will receive inadequate attention. Fires or explosions which will interfere with the production of urgently needed materials may be expected unless extraordinary care is taken.

One such material which has been the subject of recent publicity is synthetic rubber. In years past practically 100% of our rubber supply has been imported, but synthetic substitutes are now being rapidly developed. For years we have heard of the synthetic rubber produced in Germany. At first it was said to be of inferior quality, but the methods of its production have now been so improved that the synthetic product is actually superior to natural rubber for some uses. The price of the synthetic product is higher than that of natural rubber, but with increasing production in the United States, the cost is being reduced and one of the leading tire manufacturers is already reported to

have under construction a plant for the production of synthetic rubber for use in automobile tires.

There are many varieties of synthetic rubber, slightly different in chemical composition, process of manufacture, and properties. They all, however, are made from flammable materials involving fire and explosion hazards unless proper safeguards are observed. The types of synthetic rubber products receiving the most current publicity have as their basic raw material a flammable liquid known as butadiene. This is a petroleum product produced by a "cracking" process and would appear to have fire hazard properties similar to those of other highly volatile flammable liquids. It has certain chemical properties in common with acetylene; and incidentally, acetylene is reported to be the starting point in the synthesis of the first type of synthetic rubber produced commercially in the United States. It may be recalled that two years ago there was an explosion in connection with this particular process (QUARTERLY, January, 1939, page 203).

The "buna" process of synthetic rubber manufacture is essentially one of polymerization or the combining of individual molecules of butadiene and other products to produce the complex molecules of rubber-like products. The possible hazard of butadiene is reflected in the following report published in the May 10 issue of the News Edition of the American Chemical Society.

Hazards with Butadiene and Its Peroxides.

D. A. Scott, Shell Development Co., Emeryville, Calif.

Certain information concerning unusual hazards which may be encountered in working with butadiene and related compounds has come to our attention and is recorded here for the benefit of others.

Butadiene, when heated under pressure, may undergo violent thermal decomposition. In one instance, explosive decomposition with carbon formation occurred on heating butadiene in a stainless steel bomb, while previous similar experiments gave no unexpected occurrences. Perhaps enough material was placed in the bomb so that it became entirely filled with liquid on heating, and the hydrostatic pressure may have initiated a decomposition similar to that taking place in acetylene upon compression. No explosions resulting from heating at atmospheric pressure have been observed in the absence of oxygen.

In contact with air or oxygen, butadiene may form violently explosive peroxides and may be detonated by either mild heating or mechanical shock. Solid butadiene, exposed for a very short time to oxygen at subatmospheric pressure, absorbed sufficient oxygen so that on warming slightly above the melting point a violent detonation occurred. It is suspected that this behavior of butadiene is influenced strongly by the accidental presence of oxidation catalysts or inhibitors. Addition of an inhibitor to butadiene which is to be distilled or allowed to stand in contact with air or oxygen, even at low temperatures, would help avoid explosions.

After emptying a storage tank of crude butadiene, some polymer was found at the bottom. The polymer contained 0.095 equivalent of peroxide oxygen per 100 grams and could be detonated easily by a hammer blow. The polymer con-

taining the oxygen compounds was insoluble in the butadiene, and the butadiene itself showed only a trace of peroxides. The peroxides probably were formed by reaction between butadiene and air. Subsequent investigation showed the peroxide could be destroyed safely by treatment with strong caustic soda (48° Bé.; 47 per cent sodium hydroxide).

Reports indicate that the Standard Oil Company of New Jersey, the duPont Company, the Dow Chemical Company, and various other large concerns, are actively interested in the production of synthetic rubber. These large and experienced chemical concerns, accustomed to handling highly combustible and explosive products, may be expected to appreciate the potential hazards involved, and employ all reasonable safeguards. The danger lies in the possibility that under emergency conditions products such as these may be manufactured by concerns without the requisite experience in the field and the handling of hazardous materials may be entrusted to men unfamiliar with their properties.

Meetings of Board of Directors.

Atlantic City, May 8, 1940.

Present.

Albert T. Bell, Chairman
Samuel D. McComb, President
Alvah Small, Vice-President
David J. Price, Vice-President
Hovey T. Freeman, Secretary-Treasurer
George W. Elliott, Past President
Harold L. Miner, Past President
Franklin Wentworth
Percy Bugbee, General Manager
A. L. Brown
Russell Grinnell
C. W. Johnson
A. H. Kehoe
C. W. Pierce
Richard E. Vernor
John L. Wilds

Business Transacted.

1. The report of the Chairman of the Board to the annual meeting was read and approved.

2. The report of the Treasurer was approved.

3. The request of Chairman Newell of the Committee on Gases to change the place of the Committee's report on the program schedule was declined with regret.

4. The request of the Illuminating Engineering Society for representation on the Electrical Committee was referred to the Committee on Technical Committee Procedure for consideration and later report to the Board.

5. It was voted to hold the next meeting of the Board in Boston on Monday, June 24, 1940.

Boston, June 24, 1940.

Present.

Albert T. Bell, Chairman
Alvah Small, President
David J. Price, Vice-President
Richard E. Vernor, Vice-President
Hovey T. Freeman, Secretary-Treasurer
Samuel D. McComb, Past President
George W. Elliott, Past President
A. L. Brown
H. T. Cartlidge
Frank A. Epps
Russell Grinnell
C. C. Johnson
C. W. Johnson
Arthur H. Kehoe
W. E. Mallalieu
H. L. Miner
C. W. Pierce
W. J. Scott
H. Sidney Smith
Leon A. Watson
Lloyd T. Wheeler

N.F.P.A. Staff: Percy Bugbee, Robert S. Moulton.
Horatio Bond, Franklin Wentworth.

Business Transacted.

1. The following members were elected officers of the Corporation for the year 1940-41: President — Alvah Small; Vice-President — David J. Price; Vice-President — Richard E. Vernor; Secretary-Treasurer — Hovey T. Freeman; Chairman, Board of Directors — Albert T. Bell.

2. The Advisory Committee for 1940-41 was appointed, to consist of Albert T. Bell, Chairman; Alvah Small; David J. Price; Richard E. Vernor; Hovey T. Freeman and C. W. Pierce.

3. Messrs. C. C. Johnson and C. W. Johnson were selected to complete the Nominating Committee for 1941.

4. The selection of the dates and place of the 45th annual meeting was referred to the Advisory Committee with power.

5. The appointment of a Program Committee for the annual meeting was referred to the Advisory Committee with power.

6. A proposal for commercial and educational exhibits at annual meetings was discussed and referred to the Advisory Committee for report at the next meeting of the Board.

7. The budget prepared by the General Manager and presented, with amendments, by the Finance Committee, was approved.

8. The recommendations made in President McComb's address at the 1940 annual meeting were acted upon as follows:

(*a*) A Committee on Museums, Art Objects and Historic Buildings was created and the appointment of the personnel was referred with power to the Committee on Technical Committee Procedure in consultation with the President.

(*b*) The proposed appointment of a committee on the parking problem was referred to the Executive Office for investigation of the activities of other organizations in this field and the possible contribution that the N.F.P.A. might make toward a solution of the problem, with report to the next meeting of the Board.

(*c*) The preparation of a model enabling act to permit the adoption of codes by title or reference was referred to the Committee on Laws and Ordinances.

9. The General Manager was authorized to investigate the proposed establishment of an endowment fund plan and to report thereon at a subsequent meeting of the Board.

10. On recommendation of the Committee on Gases, in accordance with the action of the 1940 annual meeting, the following amendments in the standards for the Design, Installation and Construction of Containers and Pertinent Equipment for the Storage and Handling of Liquefied Petroleum Gases were adopted:

Insert at the end of Section B.9 and under the general heading, "Safety Devices," a note to read as follows:

"Note: Frequent testing of safety relief valves, as would be required where there is a probable increase or decrease of the releasing pressure of the valve due to clogging, sticking, corrosion or exposure to elevated temperatures, is not necessary for such valves on liquefied petroleum gas containers for the following reasons.

"The gases are so-called 'sweet gases,' i.e., they have no corrosive effect on the metal of the container or valve; the valves are constructed of materials not readily subject to corrosion and are installed in pressure vessels so as to be protected against the weather. Further, the temperature variations are not sufficient to bring about any permanent set of the valve springs. Another reason is that the gases are odorized and instant warning is given of any escape of gas. Although general storage of these gases has been on a widespread scale for approximately thirteen years, industry experience has not shown any cases of these safety valves not functioning properly.

"It is recognized, however, that like all mechanical devices, these valves cannot be expected to remain in reliable operative condition forever, hence it is suggested that in the case of containers exceeding 1000 gallons water capacity, they be tested at approximately 5-year intervals. When valve is of type necessitating removal for testing, container must first be emptied. When type of valve permits, testing may be accomplished by an external lifting device equipped with an indicator to show the pressure equivalent at which it opens."

Insert at the end of paragraph B.3 under the general heading "Requirement for Construction and Original Test of Containers" a new sub-paragraph as follows:

"Compliance with these provisions requires that such containers shall be constructed and marked only in shops so authorized by the Code authority in question."

11. The following action was taken on matters relating to the American Standards Association:

(*a*) It was voted not to submit the 1940 revision of the standard on Air Conditioning to the A.S.A. as a revision of the previous N.F.P.A. standard submitted to and approved by the A.S.A. The Executive Office was instructed to inform the A.S.A. office that in the opinion of the Board of Directors the art of air conditioning is now undergoing such rapid development and change, with the consequent neces-

sity of frequent revisions of the N.F.P.A. standards on this subject, that it is not at the present time advisable to submit these standards for approval as American Standard.

(*b*) The Executive Office was authorized to submit to the A.S.A. for approval the 1940 revisions in the Building Exits Code as recommended by the Committee on Safety to Life and adopted at the 1940 annual meeting.

(*c*) The Executive Office was authorized to submit to the A.S.A. for approval under the proprietary sponsorship method the 1940 revisions to the standard "Recommended Good Practice for the Installation of Piping and Fittings for City Gas" (adopted by the A.S.A. as an American Standard in 1933) as submitted to the Association by the Committee on Gases on recommendation of the American Gas Association, and adopted at the 1940 annual meeting.

(*d*) The Executive Office was authorized to submit to the A.S.A. for approval as American Standard, the Code for the Prevention of Sulphur Dust Explosions and Fires prepared by the Committee on Dust Explosion Hazards and adopted at the 1940 annual meeting.

(*e*) On recommendation of President Small, it was voted to concur with the other members of the Fire Protection Group in discontinuing participation in the work of the sectional committee for the National Electrical Safety Code.

12. The report of the Committee on Technical Committee Procedure was accepted, including action on the following items:

The committee reported consideration of requests for additional representation on the Electrical Committee which were referred to it by previous meetings of the Board. This subject was left in the hands of the Committee on Technical Committee Procedure for subsequent report.

The Committee on Manufacturing Hazards was suspended and new committees to cover this field were created as follows:

FINISHING PROCESSES — to cover the present standards on Dip Tanks and Paint Spraying and Spray Booths, also other finishing processes such as fabric coating and impregnating.

OVENS AND FURNACES — to cover the present standards on Ovens, also bakery ovens, core ovens and annealing and heat-treating furnaces.

SPECIAL EXTINGUISHING SYSTEMS — to cover the present standards on Foam, Carbon Dioxide and Inert Gas, Water Spray Systems and also steam, carbon tetrachloride spray systems and other special systems when and if such additional standards become necessary. (The title "Special Extinguishing Systems" is intended to indicate that the scope does not include hand fire extinguishers, automatic sprinklers, etc.)

The present Association standard on Spark Arresters was transferred to the jurisdiction of the Committee on Field Practice.

A Manufacturing Hazards Council was created, consisting of the chairmen ex officio of the Committees on Dust Explosion Hazards, Finishing Processes, Flammable Liquids, Gases, Hazardous Chemicals and Explosives

and Ovens and Furnaces, with authority to add the chairmen of any other special hazard committees which may be subsequently created. Approval was given to the scope of this Council to act in an advisory capacity to the Association and other committees, calling attention to new processes and hazards which may require attention, suggesting their consideration by the appropriate existing committees or by the creation of new committees as circumstances may warrant, and retaining the present function of the Committee on Manufacturing Hazards in sponsoring advisory reports on special hazards, but not itself undertaking the preparation of standards.

Mr. Benjamin Richards, Chairman of the Committee on Manufacturing Hazards, was appointed Chairman of the Committee on Finishing Processes and also Chairman of the Manufacturing Hazards Council. Appointment of the balance of the personnel of the new committees was referred to the Committee on Technical Committee Procedure with authority to proceed, subject to confirmation by the Board.

The Committee on Control of Incipient Fires was discussed and the Committee on Technical Committee Procedure authorized to proceed with a proposed change in name and scope statement.

13. The list of proposed technical committee appointments was confirmed and the Committee on Technical Committee Procedure was authorized to act on future revisions and replacements prior to the printing of the 1940 Year Book, subject to confirmation at the next meeting of the Board. Changes in the personnel of the Committee on Laws and Ordinances and on Membership were referred to the President with power. (The revised personnel of the committees will be shown in the 1940 Year Book.)

14. President Small reported a proposal from Walter R. MacCornack, Chairman, N.F.P.A. Committee on Fire Protection Engineering Education, Dean of Architecture Massachusetts Institute of Technology, that M.I.T. conduct a 2-year research on gases produced in fires. It was voted to commend this proposal as having most useful potentialities, and to appoint Board member John L. Wilds as a committee of one to maintain contact with this research project.

15. Franklin Wentworth, who has been in the N.F.P.A. Executive Office in a consulting capacity since his retirement as Managing Director in June, 1939, announced the cessation of his connection with the Executive Office as of July 1, and his plans to reside in California. President Small on behalf of the Board expressed admiration and esteem for Mr. Wentworth, very best wishes for his happiness in his new environment, and the hope that members of the Board and of the Association might continue to maintain contact with him in the years to come.

International.

Incendiary Bombing of Oil Tanks.

This photograph, made from a British Royal Air Force plane, shows a burning oil tank at Dunkirk ignited by bombs from R.A.F. planes after Allied troops had evacuated the port. This picture shows the importance of proper construction and separation of tanks as a precaution against incendiary bombing. No above ground oil tank is immune to the possibility of fire resulting from bombing which ruptures the tank and ignites escaping oil or flammable vapors. The spread of fire from one tank to another, however, may be controlled by the well-established measures of fire safety as outlined in the N.F.P.A. Suggested Ordinance on Flammable Liquids, irrespective of the cause of the original fire. Under war conditions where fire departments may be unavailable and the oil plant personnel unable to do any effective fire fighting, proper diking to prevent the spread of burning oil, adequate space between tanks to minimize the danger of spread of fire from one tank to another and standard gas-tight construction are all of great importance.

Marine Fire Fighting in New York.

By Albert B. Carlson,
Deputy Chief, Commanding Marine Division, New York Fire Department.

The history of marine fire fighting dates back to the early years of the 19th century. At that time New York City covered an area between City Hall and the Battery. After a few disastrous fires on the water front, the Common Council ordered a floating engine from an English manufacturer. The engine arrived and was placed on a barge in the East River at the foot of Roosevelt Street. The barge was propelled by oars and the pump was of the crank or coffee mill type, operated by 24 men at the cranks. This was the most primitive type of fire fighting equipment.

During the devastating conflagration of 1835, the river was frozen solid, including the floating engine. At this fire, in order to obtain water, land engines were lowered down on the ice and holes were chopped through the ice for the suctions.

The first steam fireboat, the *John Fuller,* was hired by the city in 1866, and was operated by paid firemen. This was really the beginning of our present marine fire fighting force. This boat continued in service until the completion of the original city owned fireboat, the *William F. Havemeyer,* which was first placed in service at the Battery in 1875. Her pumping capacity was 4500 gallons per minute.

The next boat built in 1881 was named after Zophar Mills, a prominent New York merchant, who was a conspicuous member of the Volunteer Fire Department. This boat was the longest boat in point of service, having been in service until 1935, with a background of 53 years of fire fighting in the Port of New York. It was the first iron hulled steam fireboat in New York. It was 120 feet in length, with a 25-foot beam. The pumping capacity was 6000 gallons per minute.

The City of Brooklyn across the river had two fireboats, the *Seth Low,* built in 1885, with a capacity of 3500 gallons per minute, and the *David A. Boody,* built in 1892, with a capacity of 6500 gallons per minute.

The *Boody,* after serving the cities of Brooklyn and New York for a period of 24 years, was declared unfit for service. All of the equipment was stripped from the boat. It was tied up to a Staten Island pier with a fireman watching it pending its disposition. One night the boat sank. The fireman managed to get ashore minus his rubber coat, boots and fire helmet. Subse-

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NOTE: This article was presented as a paper at the Seventh Annual Meeting of the N.F.P.A. Marine Section, Atlantic City, May 8, 1940. For Discussion see 1940 Proceedings, page 44.

Courtesy of Harold Vincent Smith, Home Insurance Company.

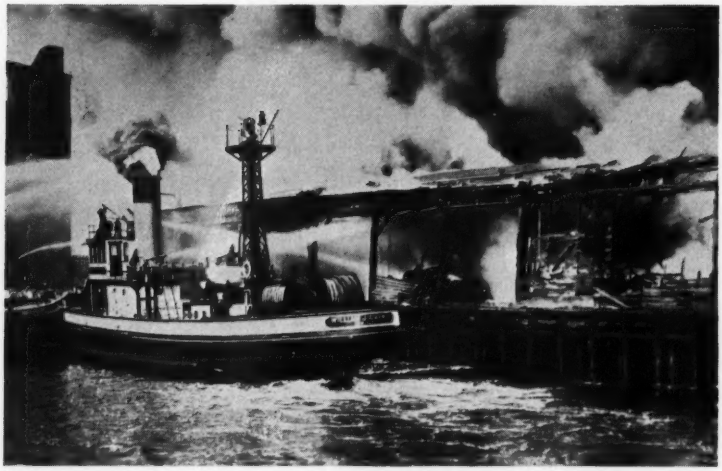
New York's first floating fire engine was a decked-over whaleboat furnished by the city to one of the volunteer fire companies. The works of an ordinary hand operated fire engine of the crank or coffee-mill type were used as the pump. The vessel was propelled by sweeps or oars manned by the members of its crew. This first fireboat was kept tied up at the foot of Roosevelt Street.

quently a towboat owner bought the boat for $1250. While the boat was being raised from the bottom of the bay, the fireman requested his fire clothing from the owner. "Nothing doing," said the towboat man. "I bought this boat as is, and your fireman's outfit belongs to me."

The *New Yorker* was placed in service at the Battery in 1891 and was then considered the latest and most powerful boat of its kind. Its capacity was 12,000 gallons per minute and it was equipped with triple expansion engines.

The boat was also equipped with portable corrugated iron shields. When fighting hot fires at close range, the firemen would place the shields in front of them while directing streams at the fire. The boat also carried 6-inch hose for supplying land lines. This hose was so heavy it took the entire crew to carry one 50-foot length.

In 1897 the *William L. Strong* was launched. It was named after the mayor at that time, but the following year when the *Strong* went into service, so did a new mayor, Robert Van Wyck. The boat was then promptly renamed after him, and when he was defeated at the next election, the boat regained its former name, *William L. Strong.* The boat is still known by that name, incidentally, and it is still in service at Staten Island. It is interesting to note that most of the New York fireboats were named after the mayors. This was the first and only instance where a boat was renamed.



Acme.

The fireboat "William J. Gaynor" pours water upon a blazing Brooklyn pier. At the stern of the craft may be seen large reels of hose for use in running lines aboard a burning ship or to a fire ashore. New York fireboats respond to all alarm boxes within 1000 feet of the waterfront.

In the year 1898 consolidation of New York and Brooklyn took place, resulting in an interchange of assignments of fireboats between boroughs. At that time there were six fireboats in service in New York Harbor, with a total pumping capacity of 40,000 gallons of water per minute.

In the early days of fire fighting in New York harbor, the fireboat commanders were having their own troubles with tugboat captains. On occasion of river conflagrations the fireboats were seriously hampered by the activity of tugboats anxious to establish a claim to salvage by attaching a hawser to the burning vessel. In 1902 legislation was passed giving the fireboats authority similar to that which was then exercised by land companies.

In 1903 and 1904 the fireboats, *Abram S. Hewitt* and *George B. McClellan*, were built. The capacity of each of these boats was 7000 gallons per minute.

Prior to 1904 the fireboats were attached to various land battalions in the city depending on where the boat was located. It was found that the fireboats were not given proper care and attention and needed immediate repairs amounting in the aggregate to thousands of dollars.

During the year 1904 a complete reorganization of the marine fire fighting force took place. The fireboat fleet became known at the 19th Battalion, with Battalion Chief John Kenlon in command.

In 1908 three more fireboats were built, the *James Duane, Thomas Willett* and the *Cornelius W. Lawrence*. They totaled 25,000 gallons capacity.

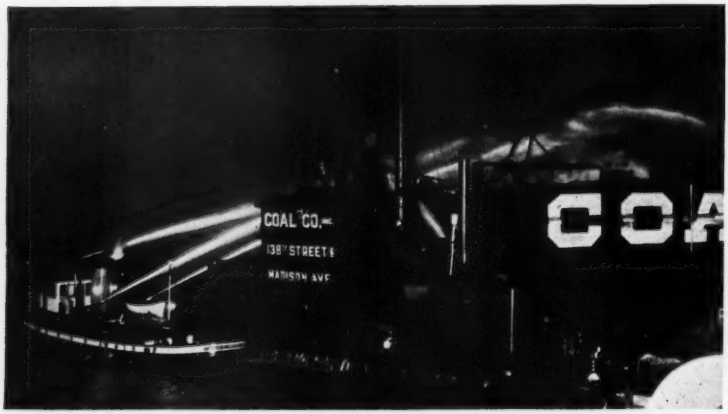
Acme.

The S.S. "City of Montgomery" reached New York in March, 1934, with a fire that had been raging in her holds for more than twenty-four hours. Two fireboats attacked the flames in the vessel, which carried twenty-nine passengers and a cargo of turpentine, rosin, lumber and cotton.

The 19th Battalion became the Marine Division in 1909, and John Kenlon was promoted to deputy chief. Three more boats were built, the *William J. Gaynor* in 1914, the *John Purroy Mitchell* in 1921, and the *John J. Harvey* in 1931, totaling 32,000 gallons per minute. The *John J. Harvey* was named after a pilot on the *Willett* who was killed in the performance of duty while fighting a fire in the German steamer *München* at Pier No. 42, North River, on February 11, 1930. During the progress of the fire a terrible explosion took place which tore a large hole in the side of the vessel, and fragments of steel flew through the air like so much shrapnel. Harvey was struck on the head and thrown from the deck of the fireboat into the river. Many of the men, including the then Deputy Chief John J. McElligott, who was in command of the Marine Division at the time, were thrown to the deck by the force of the explosion. It was very fortunate that others were not killed.

World War Activity.

During the World War the Port of New York was teeming with activity, transporting troops, munitions, war materials, machinery, dangerous chemicals, foodstuffs, etc. During this period more devastating fires occurred in piers, vessels and wharves than at any time in the history of the port. Fires increased 100%. In the year 1918, there were 201 fires in vessels and 63 in piers



International.

Fireboat "Cornelius W. Lawrence" attacks a four-alarm fire which swept a coal pocket on the Harlem River. This boat, placed in service in 1908, is one of the smaller New York fireboats. Its discharge capacity is 7000 gallons per minute.

and wharves. The Marine Division of the Fire Department was taxed to its utmost, although at that time there were ten fireboats with a total capacity of 78,000 gallons of water per minute. It was imperative that something be done to strengthen and augment the service.

A survey of all the railroad and other tugboats was made regarding pumps, hose, nozzles, etc., resulting in the establishment of a fleet of 143 auxiliary fireboats. The crews of these boats were instructed and drilled in fire fighting, thereby rendering valuable service to the fire department during the war.

The task of protecting the Port of New York from fire with its conflagration potentialities is tremendous. New York is the most important seaport in the world. More than 22,000 ships and vessels enter and leave this port each year. These vessels carry every conceivable kind of merchandise: cotton, jute, hemp, flammable oils, chemicals, explosives, etc.

During the year 1939 the fireboats responded to 1155 alarms. We had 100 fires in vessels, and 119 in piers and wharves. This does not take into account the number of fires that the fireboats operated at on land, adjacent to the waterfront.

There are 722 piers in the waters of the City of New York alone; most of them are of the old type, with no fire walls in the sub-structure. The piles under the piers are soaked with bilge oil and present very grave fire hazards. Fires under these piers are very difficult to extinguish, as very few of them have fire hatchways for the use of revolving nozzles and cellar pipes as carried on our fireboats.

Three of New York's fireboats aid in fighting a fire in an abandoned grain elevator along the Hudson River on September 6, 1939. Lighted up at the right is the powerful new "Fire Fighter," the forward monitor of which is shown throwing 6500 gallons, or approximately 27 tons of water, per minute through a 5-inch nozzle orifice. This powerful stream, equal to more than two dozen ordinary hand hose streams, tore the tile facing from the elevator wall.

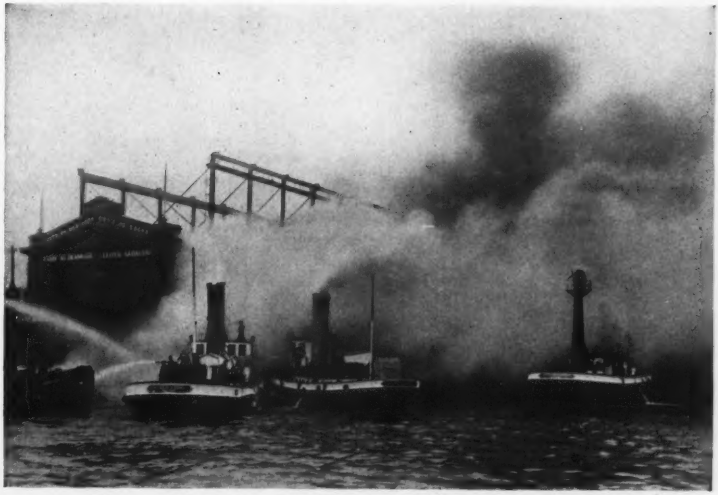
Cunard Pier Fire.

At this time I will briefly describe a fire that we had on the Cunard Steamship Company pier 54, North River, on May 6, 1932. This pier was 100 feet wide and 945 feet long, with a bulkhead building about 55 feet wide. The pier and bulkhead building was two stories high. The pier deck was of wooden planking with six inches of concrete and two inches of asphalt on top. The pier was 22 years old and had no sprinklers or fire walls subdividing the large area in the sub-structure or super-structure. The pier deck was not provided with fire hatchways.

The fire appeared to have originated under the first floor of the bulkhead building in the vicinity of the boiler room. It was discovered by a pier guard at 6:20 A.M. The exact location of the fire could not be determined at first, very little smoke being visible. Upon the arrival of the first fire department apparatus, which included a fireboat, it was apparent that the fire was spreading.

The department experienced great difficulty in getting hose streams on the fire under the pier, due to lack of fire hatchways for use of cellar pipes and revolving nozzles. The sub-structure of the pier did not have fire walls. Rafts and punts were used by the department to fight the fire under the pier, but on account of tidal conditions hose streams were ineffective; consequently the fire spread. Five alarms were transmitted during the fire, bringing more land apparatus and fireboats.

Fireboats fighting the million dollar fire at the Cunard Steamship Company pier in New York on May 6, 1932. Fire fighters were unable to effectively fight the fire in wooden piles and timbers beneath the pier deck.



Three units of New York's fireboats fleet attack a pier fire.

It was necessary to call upon the Consolidated Gas Company for air compressors and pneumatic drills in order to cut holes through the concrete for admission of cellar pipes and revolving nozzles.

Unfortunately the death of one person can be attributed to this fire. Ralph A. Kluge, a spectator, and incidentally reported as having been the designer of the steelwork of the pier, was killed when a hose line pulled loose from a hydrant, whipped around and struck him, fracturing his skull.

Despite the large fire fighting force present, the department could not save the pier, but succeeded in preventing the fire from spreading to other adjoining piers, which were connected by bulkhead buildings.

The entire sub-structure was burned to such an extent that the pier deck collapsed into the river after 12 hours, destroying valuable cargo that was on the pier. After 27 hours the fire was extinguished. During this period eight fireboats directed 35 million gallons of water at the fire.

It is interesting to note that the fire did not extend to the super-structure of the pier. If the pier deck had had fire hatchways and the sub-structure had had fire walls at proper intervals, the fire would probably have been stopped at the outset.

The New York Dock Department has in the past 22 years constructed piers embodying the latest fire safety features, and in effect has carried out to a great extent principles of pier construction as recommended by the National Fire Protection Association. It can be expected that fires occurring in the sub-structure of these piers will be easily controlled.

International.

Fireboat "William J. Gaynor" fights the fire aboard the British steamer "Silver Ash" at a Brooklyn pier in January, 1939. The freighter was loaded with cyanide and many firemen were overcome by fumes while fighting the fire.

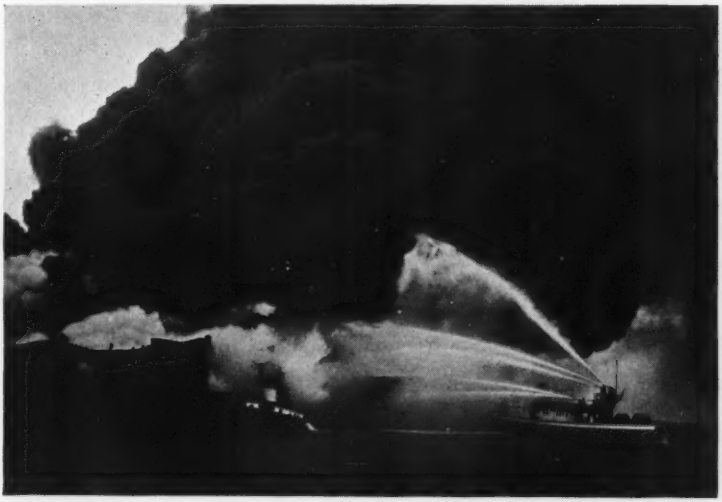
The New "Fire Fighter."

Our latest addition to the fireboat fleet is the new diesel electric fireboat, *Fire Fighter,* which was built under the personal supervision of Commissioner John J. McElligott. It is the latest and most powerful fireboat in the world and cost nearly a million dollars. It was placed in service November 16, 1938.

The boat is 134 feet long and 32 feet beam, and has a total displacement of 583 tons. There are four centrifugal pumps capable of delivering 22,000 gallons of water per minute at 150 lbs. pressure. There is a total of nine monitor nozzles, one at the bow and one on the mast aft which is 55 feet above the water line when elevated. The other nozzles are on platforms above the deck. The bow nozzle has a 5-in. orifice and delivers 6500 gallons of water per minute at 150 lbs. At 300 lbs. pressure it will deliver more than ¾ of a ton of water a second. The stream from this pipe is so powerful it will tear a pier shed apart. The firemen have named the pipe "Big Bertha."

The boat is equipped with air compressors and pneumatic pavement breakers for drilling holes through concrete pier decks, smoke ejector, self-contained oxygen masks, foam, acetylene cutting torches and every known appliance for extinguishing ship and pier fires. Lack of time prevents me from giving a more detailed description of this boat and its appliances.

On January 23, 1939, shortly after midnight, the fireboat *Fire Fighter* had its first big job. The British steamship *Silver Ash* was ablaze at a pier at the foot of 57th Street in Brooklyn. The ship was a 7750-ton freighter, 443



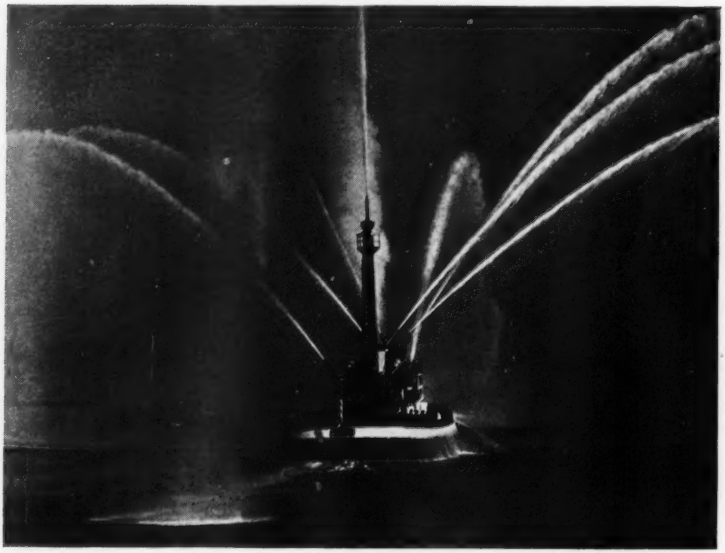
Acme.

The powerful gasoline propelled fireboat "John J. Harvey" delivering a broadside against a five-alarm waterfront fire. This boat, placed in service in 1931, throws 16,000 gallons of water per minute.

feet long, 58 feet beam. The fire started in the engine room, due to a broken oil line. Heavy black smoke was coming from the engine room and later the entire engine room was ablaze. Foam lines were advanced to the upper iron grating platform in the engine room, and skylights were opened over the engine room for ventilation. The foam was not effective because it could not be applied properly to the burning oil. The foam streams were striking several iron grating platforms and stairways at different levels of the engine room before they reached the fire. Lines could not be advanced to the floor of the engine room on account of the terrific heat. The fire spread to the adjoining cargo hold.

The cargo consisted of 270,000 lbs. of cyanide; rubber, automobiles and automobile machinery. Hose lines were stretched to open hatchways and streams were directed into the hold. At about 2 A.M. there was a terrific explosion in the hold aft of the engine room, which blew the hatch coverings into the air; several of the firemen were thrown to the deck. This was an extremely difficult fire to fight on account of the severe cold, ice coated decks, heavy black smoke from the rubber, and possibility of men being killed by deadly fumes from the cyanide.

During the night it was necessary to back the lines off the ship and fight the fire from the pier and fireboats. We burned several holes through the hull of the ship on the starboard side with acetylene torches, and operated streams



Acme.

Latest addition to New York City's fire fighting fleet, the "Fire Fighter," throws 22,000 gallons of water per minute at a pressure of 150 pounds per square inch. This craft went into service in 1938.

through these holes to extinguish the fire. The fire was confined to the engine room and one cargo hold. Twenty-nine pieces of land fire apparatus and three fireboats operated at this fire.

The fireboat, *Fire Fighter,* had its first baptism of fire and successfully operated 30 hose lines, using only two of her four pumps, discharging a total of 2½ million gallons of water. The boat operated at the fire for 12 hours.

Marine Division Personnel.

The personnel of the Marine Division consists of two deputy chiefs, three battalion chiefs, ten captains, 28 lieutenants, 40 pilots, 87 marine engineers, 52 marine stokers and 255 firemen. All work on an 8-hour basis.

We also have a Fire Service Supervising Company, consisting of one lieutenant, three marine engineers, and six firemen who are specialized marine mechanics. They respond to large fires, supervise the operation of machinery and pumps, and make adjustments, repairs, etc., on the fireboats operating at such fires.

The officers and men selected for the Marine Division in most cases are those with experience on vessels and boats of various kinds. We have men that have served in the Navy, Coast Guard, steamships, tugboats, ferry boats, etc. Some of the men have worked in shipyards at various trades.

The entire personnel of the division is made up of uniformed members of the fire department except the marine stokers. The pilots and engineers are licensed by the United States Department of Commerce, Bureau of Marine Inspection and Navigation.

We have an instruction and drill period every day to familiarize the men with the proper handling of tools and appliances, while operating at fires in ships, etc. Pilots and engineers conduct classes in navigation and marine engineering.

The entire waterfront is divided into ten company districts. Each company commander selects competent men to inspect the fire appliances on piers, wharves, and bridges, to see that they are in proper operative condition, also to see that proper aisle spaces are maintained between merchandise on piers, and to see that all laws relating to fire prevention and protection are being complied with.

The Marine Division of the New York Fire Department of today has ten fireboats and one 55-foot fireboat tender of the cruiser type. All are equipped with the most modern fire fighting appliances for combating ship, pier and waterfront fires. Each boat is equipped with two-way radio.

The boats are berthed at strategic points, and cover 578 miles of waterfront in addition to 193 miles on the Jersey side. All fire alarm boxes in important sections of the city within 1000 feet of the waterfront have fireboat assignments. The boats operate at land fires as well as ship and pier fires. It is possible for the fire fleet to pump water into the high pressure system if necessary, and furnish 96,000 gallons of water per minute at 150 lbs. pressure. This would be most essential if the high pressure pumps were out of commission. In conclusion I might add, that it is within bounds for me to say that no harbor in the world enjoys fireboat protection equal to that of New York City.

Drying by Infra-Red Lamps.

Report by Benjamin Richards, Chairman,
Committee on Manufacturing Hazards.

Drying by the radiant heat from infra-red lamps has now become common in industry. Paints, lacquers, enamels and other finishes are dried, especially in the automobile industry, and lamp dryers are used in many other ways in various industrial processes.

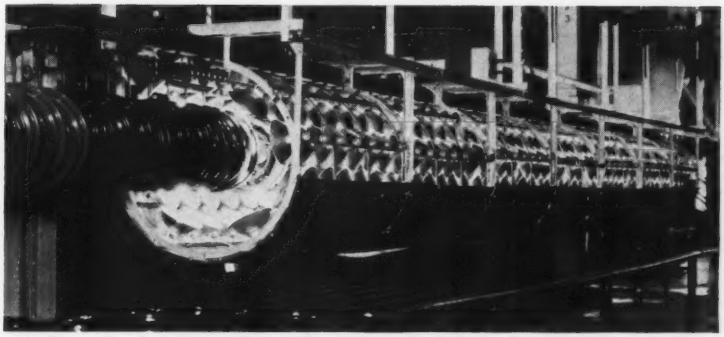
The principle used is the utilization of the radiant waves from lamps whose light waves are at the red end of the spectrum in the near invisible but visible field of light rays. The near infra-red field includes wave lengths of from about 6500 to 14,000 A. U. Most of the heating lamps used permit a utilized energy below 20,000 A. U. The violet rays at the other end of the spectrum are about 4000 A. U. The term "A. U." indicates a standard scale for measuring the length of the light waves as devised by the Swedish physicist Angstrom. The Angstrom Unit is one one-billionth of a centimeter. (Wave length in meters is 300,000,000 divided by the frequency.) Another standard sometimes used is called the millimicron, which is ten times an Angstrom Unit. This near infra-red field represents the most penetrating range of the waves for certain drying purposes and so is best adapted to such drying work.

Radiation results from any hot or heated substance, the peak wave length ordinarily shortening as the heat increases. The heat from a radiator or steam pipe is in the invisible (far infra-red) field beyond that obtained from infra-red lamps. Glowing hot substances emit a large part of their energy in the infra-red field; 80 to 90% of the energy of ordinary filament lamps is said to be in the near infra-red field.

The temperatures usually listed are temperatures at the filaments which are about 1500° K. The term "K" is used to indicate the color temperature, which is the same as Fahrenheit so far as it can be measured by color temperature measuring devices. (The sun is 6000°K; Mazda lighting lamps 2600 to 3200° K; carbon lamps about 2000° K. Some unenclosed resistance heaters are made as low as 1200° K.) The 250 watt heating lamps on the market rate at approximately 11,500 A. U. (770 B. T. U. per hour.)

These color temperatures of the lamps are not a measure of the temperature produced in ovens or lamp tunnels. The temperatures of painted surfaces and other goods being treated usually run from 250° to 350° Fahr.

NOTE: This article was presented as a committee report at the 1940 annual meeting of the N.F.P.A., Atlantic City, May 8-11. It is printed in the QUARTERLY to permit the inclusion of illustrations. For discussion see Proceedings, page 262.



Ford Motor Co.

Automobile wheels on conveyor passing through infra-red dryer.

There is nothing new in this principle of drying, as the sun drying of clothes, fruits and the like is based on the same principle. We are discussing new applications of this principle.

Some advantages of drying by infra-red lamps over ordinary gas or oil heated ovens are as follows:

Much quicker results are produced on certain classes of goods; usually a low cost of production and maintenance; better working conditions; less floor area needed; flexibility; adaptability; less odors and smoke; no oil or gas fuel hazard and no wasted fuel or power because the preheating of ovens is not necessary. Explosions are also unlikely to occur, as tight enclosures are not required. While the first cost of the lamp dryers may be high, this is more than offset by the above named gains. Also drying can be conducted without injury to other parts: *i.e.*, repairing paint defects on auto bodies after upholstering, glass setting, etc.

So far as is known, no important special chemical action takes place. The drying results from the heat from the infra-red lamps. Immediate concentration of the rays upon the work is important. Their effectiveness is also dependent to some extent on the wattage of the lamps, their distance from the work under treatment, and the type of reflectors. The lamps are most efficient in dryng paints on sheet metal work where the metal is comparatively thin and can respond to the heat. In treating larger volumes, such as thick pieces of metal, more time is required and on irregular shaped articles some of the drying necessarily has to be by conduction. Large masses cannot be heated efficiently. The effect of the lamps can be measured accurately by instruments which register the watts per square inch, but until more data are available the trial and error method probably will be most used to determine results on various products.

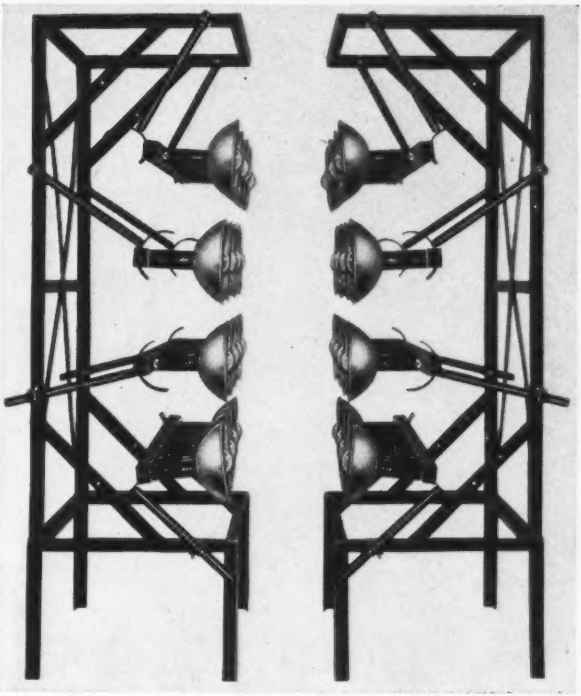
This method of drying was first developed by the Ford Motor Car Company, which controls Patents Nos. 1,998,615 and 2,057,776. These patents relate largely to the drying of enamels by the use of wave lengths less than 1.6 microns. The Ford Motor Car Company has about 40,000 of these lamps in use for drying purposes and it is said, have one such drying tunnel 80 or 90 ft. long, with possibly 5000 lamps of 240 to 260 watts each.

The lamps used in this type of drying are usually 250 or 260 watts rated at voltages 105 to 120. Some 500 and 1000 watt lamps are produced for special uses.

The lamps are usually arranged in drying tunnels, these being in the form of open cages. They are not enclosed, so the dryers are not of the type of ordinary ovens. For the best work the rows of lamps are arranged to conform roughly to the general contour of the work being dried. For instance, if automobile bodies are dried, the lamp tunnels somewhat conform to the shape of the cross sectional contour of the automobile body, the lamps being from 9 to 18 in. from the automobile. Smaller tunnels are built for smaller goods and in some cases goods on a belt conveyor pass under lamps pointing downward upon them. Some goods are treated by a bank of lamps, the conveyor carrying the goods being arranged to turn the goods so that all portions will be subject to the rays of the lamps. Long lamp tunnels can be so arranged with automatic control so that lamps with different wave lengths or intensities can be switched on or off progressively to produce any desired results on the work.

The lamp bases are usually ventilated so that the mounting cement in the bases may be kept cool. The lamps themselves do not get very hot if the shades are well ventilated and have efficient reflector surfaces. In such cases the bare hand can be placed on the back of the reflector without discomfort. Neither is the air in the tunnels heated to high temperatures. The drying effect is due to concentration of rays on the work or, more accurately, due to the heat produced by the interruption of the rays by the body of the goods being treated. This results in raising the temperature on the work only. For instance, in drying an automobile body, the rays heat the steel so that paint is largely dried from the inside outward.

The lamps are used for other purposes than drying paints, such as drying printing, latex, expanding metal parts for assembly, and all sort of industrial processes. It is said that lacquers and quick drying enamels can be dried in 5 to 15% of the time required in an ordinary oil or gas heated oven. Air drying finishes, such as synthetic lacquers, can be dried in three or four minutes. Heavy baking enamels may require 30 to 40 minutes as against 60 to 90 minutes in old style ovens. Oil paints, requiring oxidation, require a longer treatment. Finishes which reflect rays, such as whites and other light colors, require longer than the blacks and other dark colors. The absorption and reflection factors of the paints being dried are varying items to be considered.

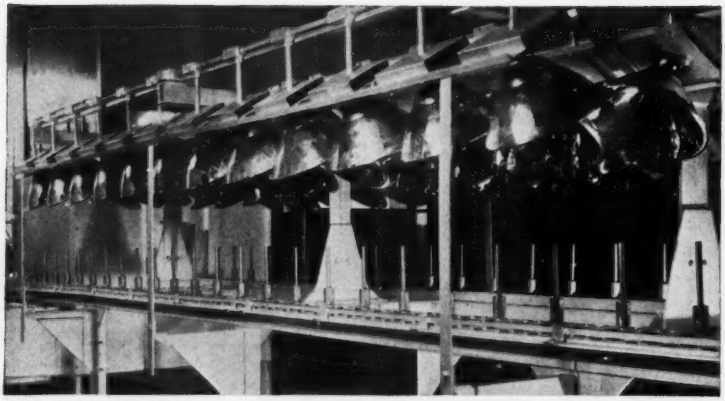


Fostoria Pressed Steel Corp.

Infra-red lamps in frame adjustable for drying parts of varying shapes and sizes.

The reflection factor of most paints is not the same for infra-red as visible light rays. The specific heat and conductivity of the material being dried is also a factor, so in drying finishes on wood, paper and such things, having low conductivity, the rays are centered on the surface to be dried, rather than to heat the material, and in such cases a low level of radiant energy is best.

The lamps are said to have a life of 10,000 to 20,000 hours and have a light output of about one-third of the ordinary Mazda lamp of the same wattage. For the transmission of the heat gun metal lacquers respond the best, followed by red primer and then the black and gray lacquers. The typical lacquers have the greatest absorption, so the solvents are quickly evaporated, hastening the final baking, which involves oxidation and possibly polymerization. Sometimes it is wise to have a different lamp at the start of the process to hasten evaporation and another type of lamp to finish the baking beyond. Where water must be evaporated, lamps with temperatures of about 2500° K give a good balance between absorption and penetration. Such lamps



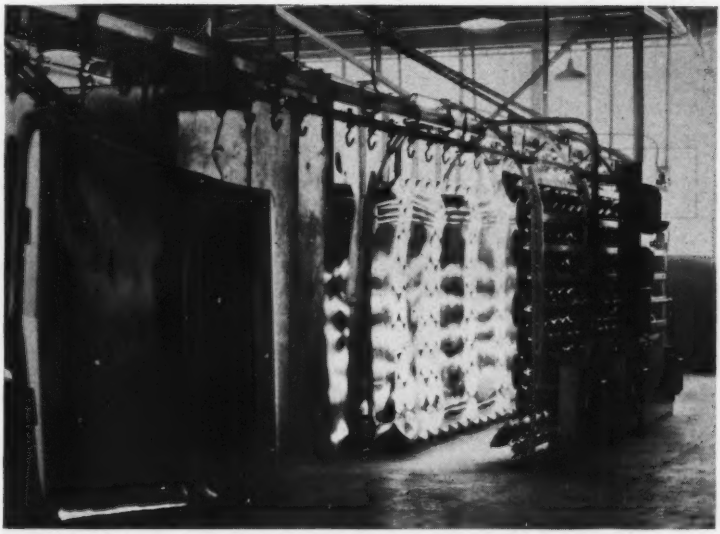
Infra-Red Ray Devices, Inc.

Dryer for small parts. Spindles rotate parts under lamps.

might be used in evaporating water from pulp, felts and other things of considerable thickness. Evaporation of solvents interferes materially with the efficiency, so where solvents are used it is best, for both manufacturing results and for safety, to have the goods first passed through a chamber or under a ventilating hood, so that the bulk of the solvents may be exhausted out of the building before the goods come into the field of the lamp rays. It is said to be wasteful to try to effect drying by projecting the radiation through a considerable amount of solvent vapors. Efficiency can also be gained by enclosing the conveyor beyond the lamp tunnels that the heat in the goods may be retained and so fully utilized. There is said to be about 15% increase in efficiency if the lamps are staggered, with the reflectors touching each other rather than when arranged in rows with spaces between the reflectors. The lamps are usually 6 to 18 in. from the surfaces being dried. If too close "spotty" drying may result. Some special lamps have prisms, something like the lighthouse type, to direct the rays. Usually tests must precede the designing of a dryer to adapt the process to each particular class of work.

Some enclosed infra-red lamps are on the market, but we are told that they are less efficient than the open lamps and are thereby not likely to be generally used. The vented reflector shades on the open lamps seem to add to their safety.

The type of reflectors used is very important. There are two general types, spherical and parabolic, varying in diameter at their rims from 6 to 14 in. The former are designed to diffuse the rays and the latter concentrate them. Gold plated reflectors are commonly used, as they are the most efficient because the gold plating does not readily tarnish. Copper and silver plating and some other finishes are efficient when bright, but they tarnish readily and



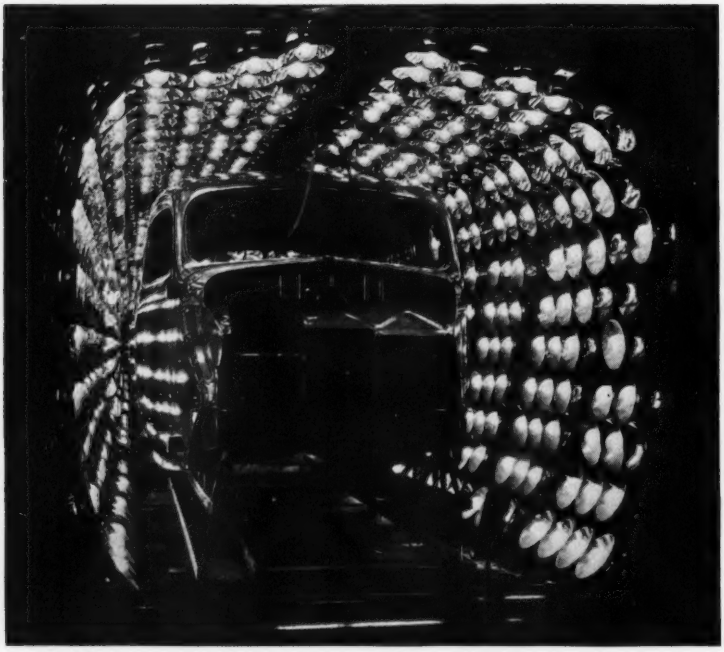
Infra-Red Ray Devices, Inc.

Drying tunnel for automobile tops.

the use of such types is impractical because of the cost of keeping them polished. Aluminum is used and is fairly efficient, the aluminum plating being of two kinds — processed aluminum and polished aluminum. Chromium plating is fairly efficient. The parabolic reflectors are more commonly used where it is desired to concentrate the rays on a definite area such as in spot drying. The gold lined and other good reflectors project most of the heat outward so the backs of such reflectors are comparatively cool. Drafts must be avoided, so any ventilation used for taking out solvent vapors must be arranged separately from the drying areas, and to utilize the heat on the goods after treatment, drafts should also be avoided. In drying certain thermoplastics and other goods requiring quick cooling, air blasts or a refrigerating section follow the drying section of the tunnel.

So far it is found that when such drying tunnels are placed in comparatively large rooms they apparently are safer than old style drying ovens even though large amounts of solvents are evaporated. As there is no enclosure, the solvent vapors diffuse about the room, so they are not concentrated and extra hazardous conditions are thereby avoided. Smoke and other by-products of the baking are less than those produced by old style ovens.

Ordinarily insurance interests might consider the electric equipment used as requiring the class of apparatus called for in hazardous locations, but experience to date shows that ordinarily such locations need not be con-



Ford Motor Co.

Automobile body in infra-red drying tunnel.

sidered as "hazardous areas," under the usual meaning of that term. At any rate it is impracticable to call for vapor-proof or explosion-proof lamps. As stated before, some vapor-proof lamps of this type are on the market and may be used in unusual and specially hazardous places. It will be necessary to gain further experience before accurate conclusions can be reached regarding the general safety of the process.

One item which may call for attention is that, where there is drying by infra-red lamps, there may be a tendency to increase the use of fast drying solvents in spraying and dipping, as the use of such solvents would tend to increase the efficiency of infra-red lamp dryers.

One concern is experimenting in using the infra-red principle in a gas or oil heated oven. This is done by heating plates to the proper color to produce the infra-red rays. This paper, however, is confined to the use of electric lamps, but our Committee will follow this new development during the year. Obviously this principle and method as applied to gas and oil heated ovens seems to involve more serious hazards than the use of electric lamps.

We offer the following suggestions which might be taken as a tentative report for guidance during the year pending further study of this subject and possibly the presentation of some more detailed rules next year. The suggestions are as follows:

1. All electric equipment should be of approved type and installed in accordance with the National Electric Code.

2. In drying goods involving the evaporation of considerable amounts of flammable solvents by infra-red lamps such installations should not be confined in small rooms unless such rooms are thoroughly ventilated.

3. Where the evaporation of a considerable amount of flammable solvents is involved, ventilated hoods or enclosures should be built at the first part of the conveyor with exhaust systems to discharge the first evaporation from the solvents outside so that when the goods progress to the lamp drying tunnels a comparatively small amount of solvent is left for evaporation. Preferably a space between such ventilating section and the drying section should be maintained.

4. A similar ventilating system could be installed to precede the drying where goods give off flammable dust, waste, deposits, etc., which might collect on the drying lamps.

5. Lamps and other electrical equipment should be kept free from flammable deposits and adequate cleaning carried out as a regular program where needed.

6. Lamp drying units should be well separated from spraying and dipping processes.

7. Controls should be provided so that the lamps in the tunnels will be shut off automatically if and when the conveyor stops.

8. If there are no conveyors, the goods being left stationary in the dryer, there should be a time switch to shut off the lamps to avoid overheating the stock if it is not removed from the dryer on time. That would guard somewhat the human element hazard.

9. Goods on conveyors should be rigidly supported so as to be not liable to displacement and so cause lamp breakage and short circuits. Where there are no conveyors, goods should be fixed on dollies running on tracks to accomplish the same result.

10. Special protection, if required, should consist of automatic sprinklers or approved water spray systems over the lamp tunnels and under ventilating hoods or an approved automatic CO_2 gas fire extinguishing system should be provided.

Arson in Times of War.

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On Sunday, January 21, of this year, there appeared in the *Chicago Tribune* a story headed, "Mystery Plant Builds Motors for War Planes." The story told of a new $6,000,000 plant spread out over a 53-acre tract of land in Indiana to be used for the production of airplane motors of secret design. Relatively unimportant was the fact that such a huge plant had recently been constructed for the production of airplane motors of secret design. What was important was the fact that the new plant was, as far as government engineers could determine, absolutely saboteur-proof. At least, they were certain that the possibilities of damage by saboteurs had been reduced to a minimum.

The *Tribune's* story stated that the new plant was surrounded by an electrically charged fence, that it was constantly floodlighted at night, that there were three picket lines of armed guards at all entrances. To frustrate saboteurs, the building had been divided into steel walled units; it had been equipped with its own well water system, its own diesel power plant. Significant was the fact that no external power failure could halt work in the plant.

Moreover, few of the employees were allowed to enter sections of the building other than those in which they worked. All employees were carefully checked and catalogued — warned that they were being entrusted with secrets of national importance.

To the average lay reader, to many a plant manager or superintendent even, it might have seemed that absurdly undue precautions were being taken in this new "mystery plant." To those acquainted with sabotage, however, and particularly arson as a form of sabotage, it was gladdening news. It raised the hope that soon industrial plants throughout the country would be protected against the ruthless (and very often clever) saboteur.

But what is sabotage? Why is it necessary to take such drastic steps to guard against it?

Sabotage is the malicious waste or destruction of an employer's property by workmen either during war or during periods of labor trouble. It is the obstructing in all possible ways of the regular processes of production. Naturally, sabotage may take several forms — as many forms as there are methods of destruction. And since fire is an effective method of destruction, it becomes obvious why sabotage more often than not takes the form of arson.

It is evident, however, that not only sabotage but *any* form of arson committed upon industry obstructs production. It is evident that, in times of war, *any* form of arson committed upon industry really has the same effect as

sabotage — that is, production is hampered, supplies are exhausted. Therefore, if we are to make a study of arson committed upon industry during times of war, we cannot very well limit our study to sabotage alone.

Motives for Arson.

The motives* for arson with reference to business and industry have been arranged under five main classifications and are as follows:

1. Economic gain. Assured benefits directly.
2. Economic gain. Assured is innocent party, but the perpetrator benefits directly or indirectly.
3. Personal satisfaction, attainment of a goal, or furtherance of a cause.
4. Concealment of some other criminal act.
5. Arson by the mentally afflicted.

In the first classification where there is an economic gain and the assured benefits directly, some of the more important motives are as follows:

a. Quick liquidation of a business enterprise.
b. Settlement of an estate.
c. Absence of a ready market for the stock.
d. Obsolescent merchandise or machinery.
e. Failure to receive expected orders.
f. Termination of a seasonal business.
g. Desire to avert failure.
h. Urgent need for ready cash.
i. Sale of land without buildings.
j. Inability of manufacturer to fulfill certain contracts. (Quite often clause included in contract to effect that in event of fire the manufacturer is not to be held responsible for unfilled orders.)
k. Desire to terminate a partnership.
l. Business quarters outgrown.
m. Desire to move from a certain locality.
n. Assured has been able to obtain too much fire insurance coverage.
o. Building has been condemned because of unsanitary conditions.
p. Scarcity of raw material.

Where there is economic gain and the assured is an innocent party, but the perpetrator benefits directly or indirectly, some of the more important motives and persons who might foster such motives are as follows:

a. Adjusters — to secure contract to adjust the loss.
b. Insurance agents — to stimulate business.
c. Building contractors — to secure the contract to
(1) Rebuild. (2) Wreck.
d. Competitors — to stifle competition.
e. To secure employment as
(1) Watchman. (2) Fireman. (3) Policeman.
f. To secure contract to handle the salvage or to purchase salvaged material.

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*For further discussion regarding motives for arson see "What About the Moral Hazard?" by the writer. *The Weekly Underwriter*, December 2, 1939, Vol. 141, No. 23, pp. 1161-1164.

Fires started for some personal satisfaction, for the furtherance of a cause, or for the attainment of some goal have indeed been numerous and costly. Many of these motives occur during national or international crises and thus, are of the utmost importance today. In this classification are:

a. Sabotage.
b. Riots.
c. Strikes.
d. Hatred.
  (1) For revenge.
  (2) For spite.
  (3) As a result of jealousy.
  (4) As a result of feuds.
e. Intimidation.

Sabotage has already been defined in this paper as the malicious waste or destruction of an employer's property by workmen, and the obstructing of the processes of production. It is at once evident that explosives, incendiary bombs, and fire are effective tools with which the saboteur might work. They are particularly effective tools when it is considered that sabotage is always carefully planned and secretly committed so that the saboteur may remain undetected and in a position to repeat his destructive work when the opportunity arises.

The object of the saboteur may not necessarily be the complete destruction of a large manufacturing plant. His object may be merely to damage machinery or processing equipment or the raw or finished materials. Or, the saboteur may have as his objective, the interruption of work in several manufacturing plants by the destruction of a power plant or lines.

When hatred is the motive for arson, any one of several situations is possible. Not uncommon in this category is the fire that was started by a discharged or disgruntled employee. The "torch" perhaps claims the assured owed him money, or possibly he was fired or rebuked by the assured for stealing from the premises. One fire was started (and resulted in the snuffing out of many innocent lives and the destruction of property) merely because the person responsible for the fire claimed he was maltreated and teased by the owner.

Strikers have confessed plans to dynamite or set fire to buildings where they have been employed so that "scabs" would no longer have jobs. In certain sections of the country the burning of the home or barn of a neighbor with whom there has been some disagreement is not uncommon. Racketeers have found the torch and bomb more terrifying than the blackjack or gun.

Other Motives for Arson.

Resorting to arson in an attempt to conceal some other crime includes a variety of motives which may be classified as follows:

a. To obliterate evidence.
  (1) To cover up the fact that there is a stock shortage.
  (2) To destroy records.
  (3) To conceal murder, burglary, or larceny.

b. To divert attention of watchman, custodian, law enforcement officer, or general public.
  (1) For purpose of looting premises.
  (2) To burglarize another location in the same community.
c. To break out of jail, penitentiary, state hospital or some other institution.

The country grain elevator manager sometimes burns his elevator when the company by whom he is employed contemplates an audit of his records. Dishonest bookkeepers and accountants who have been indulging in pleasures and luxuries which their income will not warrant have resorted to arson to destroy records showing embezzlement, forgery, and false entries. Safe blowers and others who have committed burglary, often use explosives and incendiary bombs in an attempt to destroy the physical evidence of their crimes. Murderers, at times, try to conceal their victims and evidence by setting fire to the room, house, building or car containing the body.

And lastly, we will consider briefly persons who are motivated to commit arson because of certain mental afflictions, as follows:

a. Sufferers from some form of insanity.
  (1) Pyromania.
  (2) Paranoia and religious fanaticism.
b. Psychopathics without a psychosis.
  (1) Policeman "discovers" fire he started and turns in alarm.
  (2) Fireman starts fire in order to make spectacular rescue of building occupants.
  (3) Desire to create excitement. The thrill of seeing fire department in action.
  (4) Desire to accomplish something. A means of satisfying the "ego" even though the accomplishment is of a destructive nature.
c. Drug addicts and alcoholics.
d. Idiots, imbeciles and morons.
e. Epileptics.

A pyromaniac is one who starts fires because of an irresistible urge, desire, or passion for fire. His craze for fire may be satisfied only by starting the fire. In other cases, satisfaction may be realized by merely watching leaping flames. Other pyromaniacs seem to derive some sexual gratification during the perpetration of the act or during the course of the fire.

The paranoiac suffers from a chronic mental disorder characterized by systematized delusions of persecution and greatness, sometimes with hallucinations. Persons who have been discharged or employees who believe they are being persecuted by their employers because of their failure to receive wage increases, promotions, or special favors may be diagnosed as paranoiacs when they resort to arson as a means of retaliation.

Alcoholics have been known to start numerous fires while under the influence of liquor. Imbeciles, morons, and idiots have also caused fire departments a great deal of trouble along these lines, and epileptics have been known to commit arson.

Methods and Materials Used by Arsonists.

The methods employed and the manner in which incendiaries operate (generally referred to as *modus operandi*) are undoubtedly more numerous and more varied than those employed by any other class of criminals. There is often some connection between the method used in starting the fire and the motive for the crime. Fires started by saboteurs or by those who stand to gain economically are frequently ignited by more ingenious and complicated methods than those started in an attempt to conceal some other crime or where the mentally afflicted are involved.

Materials and substances which have been employed by the arsonist to perpetrate his deeds may be classified as follows:

A. Combustible materials, oils, volatile liquids and other chemicals.
B. Mechanical contrivances and trailers.
C. Gas and electrical appliances and contrivances.
D. Flammable gases.
E. Chemical apparatus.
F. Explosives and bombs.

It has been observed in the past that it is usually more difficult to determine the cause of a factory or warehouse fire than it is to determine the cause of fire in a dwelling house or on some agricultural property. Since this is true, it is obvious that the "professional" arsonist, the arsonist who attacks industrial plants and stores (and the saboteur is included in this classification), has at his command a knowledge of the most positive and ingenious incendiary materials and methods.

In an analysis of the above classifications, therefore, we shall deal particularly with (E) chemical apparatus and (F) explosives and bombs, for we consider these methods of prime importance in times of war. However, we *do not* and *cannot* minimize the dangers from sources other than these.

A few of the items which are included in the classification, "Combustible materials, oils, volatile liquids and other chemicals" are as follows:

1. Journal box waste obtained from railroad cars.
2. Candles — tallow, wax, paraffin.
3. Gasoline or oil-soaked burlap or rags wrapped around club or rock.
4. Newspapers and trash.
5. Lubricating oil.
6. Kerosene.
7. Fuel oil.
8. Turpentine.
9. Alcohol.
10. Benzine.
11. Gasoline.
12. Ether.
13. Paint.
14. Paint remover.
15. Varnsh.
16. Lacquer.
17. Rubber cement.
18. Metal polish.
19. Stove polish.
20. Cleansing fluid.
21. Celluloid.
22. Nitrocellulose film.
23. Metallic sodium.
24. Phosphorus.

Some of the containers found at the scene of the crime which held the liquids used by the arsonist are bladders, rubber gloves, hot water bottles, inner tubes, jars, jugs, bottles, vases, pans, lard cans and cellophane bags.

Mechanical contrivances and trailers include the following:

1. Alarm clock arrangements.
2. Lighted lamps and lanterns.
3. Trailers made of fuse, candlewicks, rope, cloth, paper and celluloid, often saturated with some flammable liquid.
4. Matches and lighted cigarettes.
5. Heating equipment deranged.

Included in the classification designated as "gas and electrical appliances and contrivances" are:

1. Gas flat irons.
2. Hot plates.
3. Electric flat irons, heaters, toasters, switches, soldering irons, and door bells.
4. Telephone boxes fixed to spark when bell rings.
5. Wiring arranged to cause short circuit.
6. Electric light bulbs placed in combustible material.

Flammable gases which have been used by arsonists to start fires are:

1. Illuminating gas.
2. Acetylene gas.
3. Sewer gas.

Chemical Apparatus and Explosives.

Perhaps the most outstanding example of the use of a chemical apparatus to start several fires (and to evade detection continuously) was that apparatus used by the agents of a foreign nation in munition depots and transport ships in the United States prior to our entry into the first World War. For although we had not entered the war, supplies were being sent abroad constantly.

The chemical apparatus used to start the fires consisted of a hollow tube made of lead and shaped somewhat like a cigar. In the middle of the tube and dividing it into two compartments was soldered a circular copper disc. One of the compartments was then filled with an acid, the other with a different acid. Both ends of the tube were sealed with acid resisting plugs.

The copper disc separating the compartments acted as a timing device, for its thickness regulated the length of time it took for the two acids to enter into a chemical reaction. The union of these two chemicals produced a flash of flame which shot from both ends of the tube. The heat melted the lead. There was no remaining evidence. The placing of such a chemical apparatus at advantageous spots in ship cargoes, warehouses, and manufacturing plants did considerable damage.

Another incendiary device used is called thermit, a mixture of powdered aluminum and a metallic oxide. When it is ignited, the aluminum reduces the oxide to molten steel at a temperature of 3000° C. It is practically impossible

to extinguish the flame from such a device. It is probable that if the present war continues, neutral and nonbelligerent nations as well as the belligerents themselves will feel the work of the saboteur. Devices such as the two already described will be resorted to undeniably.

Fires which follow explosions cause the destruction of many properties. Safe blowers often use explosives. Strikers, sympathizers or radicals also use explosives and bombs to destroy property, to intimidate witnesses, to satisfy a supposed injustice, or to display their hatred.

Explosives used include:

1. Dynamite.
2. Nitroglycerin.
3. Gun cotton.
4. Blasting caps — dynamite caps and detonators.
5. Gunpowder.

The explosion of dynamite is produced by a violent shock, initiated by a blasting cap or detonator, and not by a flame or heating. A high-power rifle bullet will explode dynamite readily. Although the material will stand some rough handling, it is certainly recommended that it be handled with the greatest of care.

When dynamite is found, it should be turned over to law enforcement authorities immediately. It will no doubt then be taken to explosive manufacturers for possible identification as to where it was obtained. Dynamite is usually made up of sticks of 1¼ x 8 in., and in the event that an odd size stick is found, it may possibly be traced. Boxes in which it is packed are marked with code numbers, thus aiding identification.

Dynamite and nitroglycerin are classified as typical high explosives. When properly set off, they explode with terrific velocity, the explosive wave traveling through the substance at the rate of 15,000 to 25,000 feet per second. The sound of such rapid explosion or detonation is high pitched and results in a violent "crack." The explosions are so rapid that they shatter the material close to the explosive.

Nitroglycerin is a somewhat yellowish or colorless oil liquid which is very sensitive to shock. It should never be poured into a water closet or sink. Since it is much heavier than water, it will stay in the trap. There it might be set off at any time by a sudden shock. One should never pour it on the ground expecting that it will evaporate and entirely disappear. Instead, it will seep into the ground, retaining its explosive qualities, and a sharp blow, as, for example, someone striking the ground with his heel will detonate it. When nitroglycerin has been spilled it can be chemically decomposed by sodium sulphide solution. This should, of course, be done by an expert.

Though innocent looking, blasting caps (dynamite caps and detonators) are high explosives. They are especially hazardous and a constant menace until actually destroyed. Their unusually bright and shiny appearance makes

them most alluring to children as well as adults. Children may try to shoot them in sling shots against a brick wall, or they may try to pick the white "stuff" out of them with a pin. One cap is sufficient to tear a foot or hand to shreds. Fulminate of mercury, the compound with which blasting caps are charged, is very sensitive to shocks and friction. Fulminate can be fired by friction, blows, fuse or by the action of sulphuric acid.

Caps when found should be very carefully separated and packed in cotton or excelsior and never allowed to remain or be near dynamite. They should be turned over to the proper law enforcement authorities immediately. Blasting caps should not be carried loosely in pockets.

To dispose of these caps burn them in the open, from behind a barricade and at a safe distance, out of range of flying particles of metal. This work should be done by an expert.

Gasoline vapors or combustible gases or vapors properly mixed with air, and gunpowder (both black and smokeless), are classified as low explosives and can usually be set off by a spark or flame. They explode much more slowly than high explosives, their speed of explosion (or burning) varying from about 300 feet per second to 2000 feet per second. Because of this comparatively slow rate of explosion, they produce a pushing effect rather than a localized shattering type of damage. The sound of such a slow explosion is low pitched and resembles a loud "boom." Low explosives usually produce a large flame, which because of its comparatively long duration may start a fire.

Gunpowder should be properly immersed in water by an expert and kept away from flame if it is to be rendered ineffective. Some bombs may be set off by a fuse or clockwork mechanism or some timing device. Other bombs are so arranged that they explode when thrown or when opened.

Ordinary safety fuse which is used in mining burns at the rate of 30 to 40 seconds per foot. Most varieties of fuse cannot be extinguished by stamping on it, or by throwing it into water. If you find a bomb with a fuse burning, grab the fuse and pull it out. You may have to pull hard and work fast. If there is not time to grab the bomb, drop to the ground, keeping your head away or covered, and lie flat until the bomb explodes. Guard your eyes.

There is no routine method for the safe investigation of unexploded bombs. They should be handled by persons experienced in the use of explosives. Since many explosives are comparatively safe when wet, a general impression exists that the best way to treat a bomb in order to render it ineffective is to place it in water. Such a method should not be adopted indiscriminately since bombs in which metallic sodium is used, or even those containing sulphuric acid, might explode by being immersed in water.

Frequently the nature and condition of the damage evidences the type of explosive or bomb responsible for the destruction. It may be determined whether the damage is of the generalized "push" type or localized "shattering"

type. However, from the extent of the damage, a very inaccurate estimate is sometimes made of the amount of explosives employed.

In the event that a bomb has been exploded in an effort to destroy a building or to start a fire, an expert should be called as soon as possible to collect bits of débris and to examine the scene. If unexploded bombs are found, it is best to call an expert to the scene rather than to send the explosives to him.

The wreckage, if carefully searched, may show fragments of fuse, wire, tape, timing device or other portions of a bomb. These must be carefully preserved for use as evidence. They not only may give excellent indication as to the nature of the bomb, but may be important for purposes of comparison to show who constructed the bomb.

Control of Malicious Fires.

No matter how careful the precautions against arson, and particularly arson in times of war, plant managements must be prepared to combat malicious fires. In general, the established methods of fire detection and extinguishment which are effective for accidental fires are equally applicable to malicious fires, but in arson and sabotage, the danger of malicious derangement of fire protection equipment is ever present.

Perhaps the most important general precaution, frequently overlooked in large scale operations, is the importance of subdividing combustible materials so as to minimize the amount of potential fuel for any single fire. Manufacturing operations or storage of products which are subdivided into well-segregated separate units, constitute one of the best precautions against major fire damage whether it be accidental or incendiary. This can be accomplished either by subdividing the operations or storage in separate well-spaced buildings or through subdivision by fire walls and by protection of vertical openings. In the latter case, more than ordinary attention should be paid to keeping fire doors closed and preventing any tampering with their operating mechanism. This can best be accomplished by very frequent inspections.

Automatic fire alarm and automatic sprinkler systems are most effective in controlling incendiary fires. The general principles of their installation will be the same irrespective of whether accidental fires or incendiary fires are to be considered. Regular inspection and supervision of all such equipment is of paramount importance wherever there may be any danger of tampering by arsonists or saboteurs. Supervision of sprinkler valves and all valves controlling water supplies for fire extinguishment is very important. In the absence of electrical supervisory service, a plan for sealing valves open may be effective when provision is made for immediate notification to the plant management if it is necessary to close valves. Similar precautions may be applied in the case of other types of fire extinguishing equipment.

Great stress is properly laid upon the prevention of access to important areas by unauthorized persons. Modern types of burglar alarm equipment may

be very useful in this connection. In measures to exclude unauthorized persons, care should be taken to avoid any extensive locking of doors or blocking of access which might delay fire fighting operations. Likewise, consideration must be given to the personal danger to employees in hazardous areas which are subject to flash fire or explosion. Their path of escape should not be blocked by locked doors. Each individual plant presents a separate problem, but with the proper understanding of the factors involved, it should be possible to prevent access by unauthorized persons without interfering with access for fire fighting purposes or emergency exits.

In times of war, it is particularly important to keep all fire extinguishing equipment in operative condition and to eliminate all potential accidental fire causes which might give the saboteur an opportunity to escape detection by attributing his malicious fire to some obvious ordinary cause such as improperly maintained electrical equipment, accumulations of rubbish and other combustible materials or like common fire causes. Stores of gasoline or other flammable liquids should be carefully maintained with the usual precautions and should likewise be checked to prevent possible withdrawal of the liquid for use in starting fires. Other similar precautions will naturally suggest themselves in any individual property.

The Watchman Combats the Arsonist and Saboteur.

In order to carry out these extra precautionary measures, the number of watchmen or custodians should be increased and these men should be well trained in the methods of fire prevention. They should know in detail the plant's facilities for fire prevention and fire fighting, and in addition know what information investigators seek when a fire of suspicious origin in the plant is under investigation. This information includes:

1. A complete statement concerning the occurrence of the fire. This includes detailed information regarding the time of discovery, progress made by the fire, and location of the fire. Also, proper jurisdiction must be determined. It should be observed that in order to constitute arson it must be proved that actual burning or ignition took place, otherwise, it may merely constitute the crime of attempting to burn.

2. It must be shown that the fire was of incendiary origin. The *corpus delicti* — the proving that a crime has been committed — must be established.

3. The establishment of a motive is not absolutely necessary, but is very helpful to the investigators. Also, a court or jury will have a natural curiosity regarding the motive in the event one is charged with arson or a kindred crime.

4. The establishment of facts and circumstances which will prove the guilt of the accused. (More than a confession is needed here.)

Watchmen and custodians are expected to perform certain duties in the event of an occurrence of a fire where incendiarism is suspected. A prescribed formula cannot be given which satisfactorily covers all aspects of this particular phase of the work, but the following is a list of the more important duties:

a. Notify the fire department and in some instances, the police department. Warn all occupants of the building of the impending danger.

b. Always carry a pen or pencil — preferably a pen — and notebook, watch, or clock when on duty. When there is an unusual occurrence, make note of it as soon as possible thereafter while the matter is fresh in your mind. It may be very important.

A few suggestions as to some events which should be recorded are:

(1) Time of arrival and departure of certain trucks or shipments.

(2) Time of telephone calls and nature of same.

(3) Complete report covering visitors on the premises.

(4) Statement covering trespassers who had to be chased or escorted off the property. Include physical description.

c. Be alert and calm and make full use of senses — sight, smell, and hearing.

d. Do not act as a sentinel, remember you are a watchman.

e. Furnish the investigators with accurate and detailed information.

f. Continue watchman service even while the fire is in progress and after it has been extinguished. Often fires break out simultaneously because of spouting systems, elevator legs, conveyor systems, air conditioning installations, or because of the work of the arsonist who has started several fires on the same property.

g. Notify the police regarding your suspicions as well as the owner of the building or business.

h. Do not permit unauthorized persons to have access to the property.

i. Prevent any person familiar with the premises and on whom suspicion rests from being present during the examination of the premises.

j. Pay particular attention to the onlookers and bystanders. Listen carefully to the statements of those in the crowd who claim they "know something."

k. Refrain from discussing the case with *anyone* except the proper authorities.

l. Do not permit the removal of any items or objects which might become important factors in the investigation.

m. Nobody should be allowed to smoke at the scene of the crime. (The careless discarding of matches at the scene may tend to increase the task of the investigators.)

n. Remain as guard on the premises until authorities have an opportunity to take charge.

o. Before answering questions, be sure you know who you are talking with.

p. Admit honest mistakes.

q. Avoid snap judgments and rash statements.

r. Do not be afraid to inform authorities as to what you "believe" or "think" about certain events.

s. Do not permit anyone to "put words into your mouth" on any pretext whatsoever.

t. Do not try to withhold information because you believe it just as well not to or because you think it does not enter into the case.

u. The watchman or custodian is often the key witness when it comes to determining the origin of the fire.

v. When a watchman or custodian is laid off — or the service is suspended — he should report that fact to the proper law enforcement authorities when he *sincerely* believes this was done to enable someone to commit a crime and attempt to avoid detection.

When a fire of unknown or suspicious origin occurs, those generally participating in the investigation are the law enforcement authorities, representatives of the fire department, insurance company investigators, and at times, an investigator employed by the owner of the property.

The law enforcement authorities are anxious to ascertain whether the fire was of incendiary origin. If it is found that such was the case, they try to obtain sufficient evidence to see that the guilty person is brought to justice. The fire department representatives are anxious to know what caused the fire in order to adopt preventive measures to avoid recurrence of a similar fire if it was the result of natural or accidental causes. The insurance company investigators are expected to find out what caused the fires that liability under the policy may be determined, or if the fire was of incendiary origin, they are glad to assist the law enforcement authorities in their task. The owner is anxious to adopt preventive measures to avoid other fires.

During the course of an investigation conducted by the investigators mentioned above, the watchman or custodian is always questioned to find out whether he has any clues which will enable them to clear up the mystery concerning the origin of the fire.

Some questions which are usually asked the watchman or custodian by the investigators are listed as follows:

a. What did you observe when you became aware of the fire?
b. Where did the fire originate or in what part of the building was the fire when you first observed it?
c. Who discovered the fire and how did you first learn of it?
d. What were the circumstances under which the fire was discovered?
e. How and why did the fire occur? What is your explanation for the fire?
f. Who could have possibly had something to do with the starting of the fire?
g. Were any person or persons loitering for unusual periods of time at or near the place you were watching or where the fire occurred?
h. What was the method of entry or exit of the suspect? Where is the exact spot the suspect was seen by you?
i. Was the building secure against anyone attempting to enter?
j. Did you notice any peculiar odors such as the odor of gasoline or kerosene at the scene of the fire?
k. What was the position of the various electric switches?
l. Have you any knowledge regarding previous attempts to burn the place?
m. Was it a flash fire? Did the fire travel with any degree of swiftness?
n. Was the stock rearranged to facilitate destruction by fire or to impede or obstruct the work of the firemen? Was there any recent change in the way the stock was piled?
o. Who possessed keys to the building or room where the fire occurred?
p. Was the building locked or unlocked before the fire was discovered?
q. Do you know of any probable motive for the fire?
r. Do you have any suggestions regarding other persons who should be interviewed by the investigators?

Some clues which are sought by the investigator when investigating a fire of suspicious origin are:

a. Accurate description of the suspect or any person or persons seen fleeing from the scene.

Include: Sex, color, approximate age, height, weight. Nationality. Build. Complexion. Eyes and eyebrows. Nose. Mustache or whiskers. Teeth. Ears. Forehead. Distinctive marks. Peculiarities. Clothes.

b. Description of the automobile or any other vehicle used by the person or persons seen fleeing from the scene.

Include: Make. Model. Color. License Number and State. Wheels. Lights — Front and Tail. Accessories. Number of Occupants.

c. Pictures of the scene — both interior and exterior — should be taken before anything is touched or moved at the scene. Also, sketches should be made as well as careful notes. Locations of certain objects and distances between certain objects must be recorded.

d. At times the ashes must be sifted in an attempt to find the remains of containers, time fuses, partially burned "plants," paper soaked with flammable liquid, candles.

e. Tables and chairs will often have left unburned marks of their legs on the floor where they were standing.

f. The state of combustion of objects at or in the fire must often be determined. The appearance of damaged objects must at times be very carefully noted.

g. Cans, jugs, or other containers which are found at the scene of the fire and which still contain some liquid such as kerosene or gasoline, must not be tipped over.

h. Tools or other items which may have been used by the arsonist and left at the scene after the fire has been started must be found.

i. Objects and materials which are at times found at the scene of the fire include:

Any of the partially burned substances or objects which were used to start the fire, fingerprints, gloveprints, tire and tool marks, footprints — in mud, dust, or snow — heavy soot covering the area where the fire occurred and probably having been produced by the liquid used to start the fire, partially burned or charred papers or records which the arsonist hoped would be destroyed in the fire.

j. The discovery that certain items of value have been removed from the building before the fire occurred or the finding of some of these objects after the occurrence of the fire and when it has been claimed by the owner that they were included in the loss, has often been one of the clues which enabled the investigators to bring the investigation to a successful and satisfactory conclusion.

Aberdeen Plywood Company Fire.

By Washington Surveying and Rating Bureau,
(Member N.F.P.A.).

Fire originating in a dryer used for drying Douglas fir veneer destroyed the sprinklered veneer panel factory of the Aberdeen Plywood Company, Aberdeen, Washington, during the early morning hours of March 1, 1940. Before the 110 men of the late night shift could get out of the building, the lighting system failed, leaving the plant in darkness. Two men lost their lives and many others narrowly escaped. Loss to building, equipment and stock was estimated at $525,000.

The plant was built in 1927. It was idle most of the thirty months prior to May, 1933, but had been in steady operation since that date. It had been enlarged from time to time and additional machinery had been installed until the capacity had reached approximately 300,000 square feet of three-ply veneer panels per day on a 24-hour production schedule. There were 440 employees. In common with most other plywood operations, the company had a very favorable order backlog.

This fire is particularly noteworthy since the plywood industry in the Pacific Northwest has expanded tremendously during recent years. Since the drying of the wood veneer is the bottleneck in the production line, operating temperatures and air velocities employed in drying machines have been gradually increased to accelerate production. Temperatures ranging from 325 degrees to 355 degrees are now commonly maintained, and an increasing number of dryer fires has resulted. Although many variables are involved, the destructive distillation of most species of wood begins at about 300 degrees and flammable gases are evolved. Furthermore, the products of distillation ignite around 400 degrees. The process of drying resinous wood (such as Douglas fir) at high temperatures results in the escape of vapors which condense in the form of pitch or resin on cool surfaces inside the building. Fine dry dusts from other operations drift through the buildings and form highly flammable deposits despite the dust collecting systems. The factories are generally large-area, ordinary-joisted, frame structures containing large amounts of combustible stock in process and storage. These factors promote flash fire conditions very difficult to control by automatic sprinkler equipment. Also, the majority of these factories are built upon wooden pilings and are unsprinklered underneath. Although the unsprinklered underfloor area was not a factor in this fire, plants where this condition exists are subject to destruction from a fire extending into underfloor areas away from sprinkler protection.

View of Aberdeen Plywood Company fire a half hour after the start of the blaze. The loss amounted to more than $500,000. Fortunately, rain was falling at the time. Rain served to protect near-by area of frame buildings and wooden shingled roofs from flying embers.

Construction and Occupancy.

The fire occurred in the main building, which was one story in height and 250 by 400 feet in area. The building was built upon piles, the north half of which was about five feet above ground. The remainder of the building was over the Chehalis River. The floor was single three-inch matched lumber partly overlaid with steel plates. Walls were one inch boards on a skeleton wooden framework. The roof was composition-covered one-inch matched lumber on rafters supported by wooden trusses on eight by ten-inch beams and ten by ten-inch posts. It was of the sawtooth type with bays 32 feet wide running north and south and wired glass in wooden frames facing east. The gutters of the roof were 23 feet above the floor and it was 26 feet to the peak of the sawtooth sections.

The underfloor space of the building was unoccupied and was subdivided by wooden bulkheads. The crane shed, office and shop additions were cut off by frame partitions. A partial partition separated the shipping department. Otherwise, roof draft stops were inadequate.

The fuel house which was badly damaged was of heavy wooden construction thirty by sixty feet. It was the equivalent of three stories in height. The boiler house was sixty by seventy feet of good incombustible construction, with reinforced concrete walls and a metal roof on an unprotected steel framework.

An eleven by thirteen foot window opening in the east wall, protected by fourteen by twenty-inch wired glass panels in steel framework, withstood the intense heat from the burning factory twenty feet away.

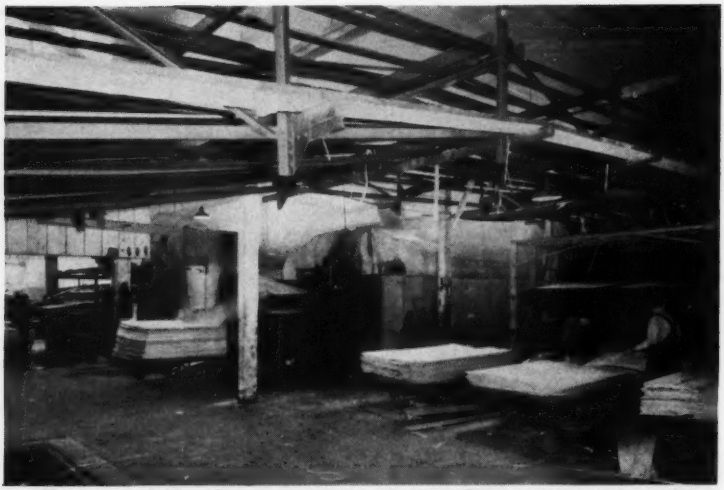
Plant processes included the usual block barking and peeling, veneer clipping, drying, sorting, patching, gluing and pressing, and sanding and finishing. The three veneer dryers in the plant were constructed of steel and were set on insulated bases. They were large dryers of conventional textile type and the operating temperatures ranged well over 300 degrees. Multiple layers of thin veneer sheets passed through the dryers continuously. The time required to reduce the moisture content of the wood veneer from thirty to forty per cent to two to five per cent, was ten to fifteen minutes. Other machinery in the plant included a battery of four multiple drum sanders, trim saws, etc. The sanding machines were serviced by a reasonably good dust collecting system which discharged directly to the boiler furnace.

Fire Protection.

The plant was protected by an automatic sprinkler system installed in 1927 and later. This system covered the entire premises with the exception of the boiler house and the underfloor and platform areas. Of 2500 sprinklers, over 2000 were located at the factory roof, and were supplied by five eight-inch and one six-inch wet pipe systems and two six-inch dry pipe systems. There were a few sprinklers along the conveyors and around isolated machinery locations in the otherwise unprotected underfloor areas. The water supply was brought into the plant from the six-inch gridironed city system 250 feet away, by an eight-inch looped main. Normal water pressure at grade was 90 pounds, and the total effective capacity indicated by a flow test was 1460 gallons per minute, with 30 pounds residual pressure at the level of the sprinklers in the factory roof. There were two four-inch siamese fire department pumper connections, but these were of no value during the fire. No secondary water supply such as elevated storage or fire pumps was provided.

A fair supply of water barrels and pails, small carbon tetrachloride extinguishers, and a good inside standpipe installation with fifty-foot lengths of 1½-inch hose with nozzles attached, offered good first-aid protection. There were also two private outside city-type hydrants and a number of standard public hydrants north of the plant-site. Watchman service with portable watchclock was maintained when the plant was not in operation.

Although public fire protection was furnished by the City of Aberdeen, no fireboat protection was available. This was unfortunate since the plant faced the river on three sides. Four auxiliary fire alarm boxes in the factory were attached to a city fire alarm box at the plant entrance.



The veneer drying department before the fire. Blaze started in dryer No. 1 at extreme right. Lathe table above the dryer had four trays with rope carriers which contributed to the spread of the fire.

Sprinkler protection in two of the veneer dryers consisted of ordinary closed 360 degree sprinklers supplied from the overhead wet pipe systems. However, these sprinklers had been installed when the operating temperatures in the dryers normally did not exceed 225 degrees and when the fire hazard was correspondingly low. Since operating temperatures and air velocities have been increased, however, it has been demonstrated, by the large number of fires originating in veneer dryers, that such a type of interior protection functions satisfactorily only occasionally, due to the extra hard degree sprinklers necessarily used. Also, the sprinklers become inoperative from pitch deposit loadings, and veneer layers being dried within the machines obstruct the even distribution of water.

In the third and newest dryer of the factory, therefore, a special deluge sprinkler system had been installed. This was a new and much better system than that which was in operation in the first two dryers, and it consisted of open shovel type sprinklers set on vertical risers to provide adequate water distribution and to flood the entire interior of the dryer, including air ducts and ventilators, quickly. The system operated either as a result of the melting of one of the "control sprinklers" or by one of the manual trips at the end of the dryer. When the system operated, the air circulation fans in the dryers stopped automatically. Unfortunately, the fire originated in a dryer which had inferior protection.

Story of the Fire.

The plant was operating on a 24-hour schedule when at about 3 A.M., fire was discovered in dryer No. 1, which was operating at a temperature of about 320 degrees. The dryer was originally designed to operate at considerably lower temperatures and air velocities, but it had been provided with additional radiation and was used principally for drying sap veneer.

The immediate cause of the fire could not be determined, but it is probable that it occurred as a result of the higher operating temperatures. Wood particles coming in contact with the highly heated steam pipes might have been ignited very easily. An accumulation of flammable gases might have been ignited by static sparks from machinery. Fan blades striking the cases, or an overheated fan bearing are also possible causes.

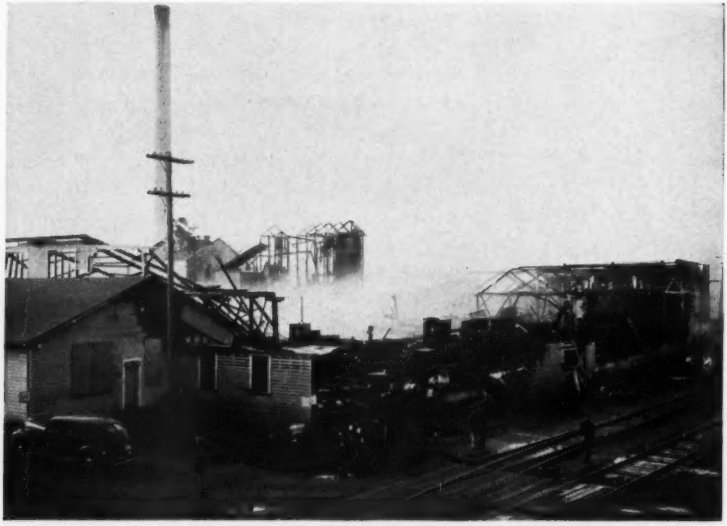
Smoke was first observed at the south end of the dryer and one of the workmen shut off all fans immediately. This necessitated his going around the entire machine. Upon his return to the south end of the machine, he went to the aid of other employees who were playing a stream from a near-by standpipe into the dryer through the openings in that end. There is a difference of opinion as to whether or not the side doors were opened. However, the first puff emitted from the openings in the south end of the dryer was said to resemble a huge lazy gas flame which did not reach the roof. This was immediately followed by a second larger flame which reached the roof and ignited the pitch and dust coated surfaces of the wooden structure. The fire was on its way.

The fire department received the first alarm by telephone, and this call was followed almost immediately and at 3:05 A.M. by a box alarm either from an auxiliary box or from the master box. Since the firemen could see flames shooting from the roof on their way to the plant, there was a considerable delay in calling the fire department.

One of the particularly bad hazards was a lathe table used for conveying veneer from one of the lathes to a clipper. This table consisted of a steel and wood framework with manila rope carriers supported from the roof structure and extending over the entire length of the first dryer. Fragments of veneer dropping from the table tended to result in an untidy condition along the top of the dryer.

This table was not in operation at the time and there were no sheets of veneer in transit to obstruct the distribution from the overhead sprinklers. Several workmen clearly recall that the fire spread rapidly over the top of the dryer along the wax-saturated manila ropes and wooden parts of the conveyor framework.

Workmen report that later the fire puffed out of the north end of the dryer. This probably happened as a result of the ignition of flammable gases which accumulated following the stoppage of the fans. Within an incredibly short time the fire was raging fiercely throughout the roof area of the drying



The smouldering ruins of the plywood factory several days after the fire of March 1, 1940. Strenuous efforts by the fire department saved the small machine shop at the left and the fire-resistive boiler house in the background.

department which was without effective sprinkler action, and was rapidly spreading to other sections. Flashing wood dust apparently accelerated the fire in some parts of the plant.

The first hose lines brought into action from the inside standpipes gave good streams. Later when several other standpipes were brought into play, the streams were ineffective. In an attempt to account for the failure of pressure this early in the fire, the outside control valve was later examined. It was found in a damaged condition and only half open. The operating nut and hand wheel were missing and the stem had been bent above the yoke, holding the gate in its half-open position.

Loss of Life.

Before the workmen had had a chance to escape from the building, the lights failed and they found themselves amidst a maze of stock piles and machinery and confronted with the task of finding the exits. It was necessary for some to crawl on their hands and knees, as the smoke gradually settled toward the floor level. Several were burned on their hands and faces.

Two workmen failed to escape. Eight men trapped in a corner of the building near the street were released through holes chopped in the frame wall by firemen who had heard their screams. A fireman attempting to rescue one of the workmen barely escaped with his own life.

Fire Fighting Operations.

The fire department responded to the telephone alarm by sending fourteen men and three 1000-gallon pumpers, one chemical truck and a ladder truck. As soon as the fire department arrived, the chief turned in a general alarm from the radio of a police car. This alarm called into action one 500-gallon pumper and eighteen off-shift firemen.

The first pumper attached two hose lines directly to the city hydrant a few feet from the plant, but since a large draft of water was already required for sprinkler operations, these lines were practically worthless. Each of the other 1000-gallon pumpers supplied four lines from other near-by hydrants and the 500-gallon pumper supplied two lines from a hydrant one block away. Some of these lines supplied deluge sets at advantageous locations. Firemen were on duty over two days, used 5600 feet of 2½-inch hose, and 1200 feet of 1½-inch hose.

Shortly after the general alarm, the first 1000-gallon pumper from which all hose had been removed was sent back to headquarters with two men. The adjoining city of Hoquiam sent a 1000-gallon pumper and two men to cover the Aberdeen headquarters.

Even while the fire department was responding to the alarm, it was obvious that the fire was beyond control. By 3:25 A.M., practically the entire building was aflame. In the meantime a mild explosion occurred and was attributed to two barrels of carbon bisulphide-carbon tetrachloride mixture used in glue mixing.

There was a moderate southerly wind at the time, but fortunately, a heavy rain was falling. For although these were not factors of importance to the fire itself, the wind blew embers for a mile or more to the north of the plant site, over a section where frame construction with shingle roofs predominates. Since the fire department did not receive any further alarms that night, it was assumed that the effect of the rain balanced the effect of the wind.

In spite of preventive efforts by the fire department, the intense heat ignited the eaves of the fuel house about fifty feet from the factory. This building was badly damaged. The fire department cooled the fire as much as possible and protected seven steel box cars containing stock which were located on a siding. They did exceptionally fine work in saving a small machine shop addition, the boiler house and other buildings along the sides of the plant. The wooden bulkheads in the underfloor area along the sides of the factory proved of valuable assistance in saving these adjoining structures.

Operation of the Sprinklers.

The sprinklers in the dryer where the fire started as well as the sprinklers in the roof above this dryer were supplied by Riser No. 3. There is no evidence of any effective action of the sprinklers on this system. Workmen

state that some water was seen coming from the dryer, where the fire originated. This may have resulted from the operation of inside sprinklers or may have come from hose streams directed into the dryer. Witnesses also state that some water was issuing from the overhead sprinklers, but that they were not effective. No one had the impression of any considerable amount of water as would have occurred had the sprinklers operated properly.

Examination of the post indicator valve on Riser No. 3 as soon as the valve could be reached, disclosed that it was open only slightly. The valve could not be completely closed due to a small obstruction in the valve seat or some internal damage. The plant engineer knew that the valve would not completely close, but on the other hand could not account for the fact that it was not wide open. It is very unlikely that an excited workman closed the valve, for nobody working at the time knew anything about the sprinkler system. The plant engineer was invariably called when the sprinkler system needed attention. If workmen had desired to shut off sprinklers in the dryer, the natural course would have been to shut the O.S. & Y. inside valve supplying only sprinklers in the dryer, but this valve was found wide open. When the post indicator valve was found practically shut, the handle was nested in a normal position. This would not have been the case had it been touched the night of the fire. It is said that this system was last shut off about three weeks prior to the fire to replace a damaged head. Whether the system had remained shut off since that time or whether it was shut off later, possibly by an unauthorized person, could not be determined.

The condition of the valve as found, confirms the report that only a small amount of water came from the sprinklers, and accounts for the fact that the sprinklers had no appreciable effect on the fire.

There is no doubt as to the operation of the other sprinkler systems, for water motor gongs were heard to start ringing successively as the fire spread through the building. Many of the workmen who were delayed in getting out of the building were drenched. As can be expected in such situations, the sprinkler systems in full operation failed to confine the fire to the area where the sprinklers were not in proper working order.

The water pressure in the plant mains and in the near-by six-inch city mains dropped to practically zero after the fire department pumpers went to work. As a matter of fact the large number of sprinklers opened had almost the same effect. A water department gauge showed that the pressure in the main distribution system of the district where the fire occurred dropped fifteen pounds within a few minutes after 3 A.M., at a time before the fire department arrived. The pressure on this gauge remained practically constant at 75 pounds throughout the night, even though three fire department pumpers later took suction from hydrants near the plant. Full pressure was restored at 6:30 A.M., when both city connections to the plant mains were shut off.

It is reported that the building and equipment loss was about $450,000, and that the stock loss was about $75,000. The stock value is said to have included about 55,000 feet of peeler blocks in the crane shed, over two million square feet of finished veneer panels in the warehouse section, and about one million square feet of veneer sheets in process. Some salvage may be obtained, but for the most part, the main factory building and the machinery were total losses. The boiler house, hog house, and electric shop were not damaged and part of the machine shop was saved. No use and occupancy insurance was carried.

Colon, Panama, Conflagration.

By Commandante L. J. A. Ducruet,
Colon Fire Department.

A major conflagration devastating twenty-four city blocks and destroying 293 buildings swept through the City of Colon, Republic of Panama, on the evening of April 13, 1940. Several thousand persons were made homeless, making more acute a housing shortage already felt in Colon due to recent increases in the Army and Navy forces and other employees at the near-by Canal Zone. The total fire loss was estimated at about $3,500,000. Reasons for the large loss were a seriously delayed alarm, congested frame construction, inadequate permanent fire force, strong wind, low water pressure and lack of proper hydrants.

Description of Fire Area.

The fire area largely consisted of tenement buildings of very inferior frame construction, mostly twenty-five to thirty years old. A few of the buildings had concrete fronts or exterior walls, but the interior construction was combustible. The buildings were only three feet apart on the average. Dry rotted timbers made many of the buildings even more susceptible to quick destruction.

Roofs were largely of corrugated iron and in many cases were painted with tar, thus making their surfaces combustible. Few of the roofs were protected by fire walls or parapets.

Story of the Fire.

As nearly as can be determined, the fire started in the kitchen of a frame building, presumably from the carelessness of a woman who was heating a large container of oil which ignited. Intending to extinguish the fire alone, the woman failed to call the fire department. Neighbors devoted their attention to saving their own property. The fire, spreading through several patios, had completely involved three buildings before the first alarm was sounded. There is testimony indicating that the fire had twenty minutes headway before

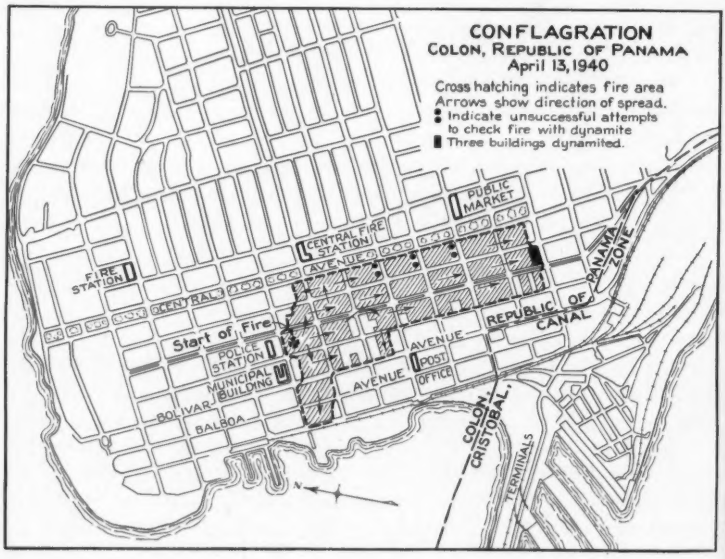
the fire department was called at 5:45 P.M. There are also indications that the person who first attempted to sound the alarm, broke the glass and turned the handle of the outside door of the alarm box without pulling the hook.

The weather previous to the fire had been hot and dry. When the fire occurred the humidity was low and a variable 14-mile an hour wind was blowing.

Fire Fighting Operations

Our fire department consists of eighteen permanent firemen, of whom only six, besides the chief and his driver, were on duty when the alarm was received. Five others were on supper hour; still others were on days off or sick leave. As soon as the chief arrived, all available fire equipment was called from the Atlantic side of the Canal Zone as well as from the City of Panama across the Isthmus. Thus, supplemented by the fire departments from Cristobal, Fort Randolph, France Field, Coco Solo and Fort Davis in the Canal Zone, and men and equipment from Panama City, nine pumpers, four hose wagons, and one small ladder truck together with 23,000 feet of hose were mobilized. In addition, two fire tugs from the Canal Zone did effective work from a landing north of the blaze.

Unfortunately, in less than two hours after the start of the fire four of the pumpers went out of service. This was a serious handicap, for water pressures were not sufficient to provide effective streams without the use of pumpers.



International.

This scene is typical of the way flames roared through the flimsy tenement buildings of Colon, Panama, during a conflagration on the evening of April 13, 1940. Volunteers and fire crews from Army and Navy posts in the Canal Zone aided the inadequately manned local fire department.

Water mains in the fire area were from four to ten inches in diameter. Most of the hydrants had only two outlets and were of inadequate capacity to properly supply the individual pumpers. Hydrant spacing was mostly from block to block and in some cases hydrants were two blocks apart. Pressures recorded at the various pumping engines varied from twenty to fifty-five pounds.

Other handicaps in fighting the fire were the lack of aerial ladders from which streams could be operated on the roofs, and the presence of high tension wires, which endangered the firemen. Much of the fire fighting was done by volunteers and by members of the army and navy fire crews. Changes in the wind direction from north at the start of the fire to east and then back to north aided the spread of the fire. The excitement of the people verged on panic, impeding the work of combating the fire. Some firemen were injured by furniture thrown from burning buildings.

The spread of the blaze was finally checked by hose streams operating along cross streets. Three attempts to dynamite buildings at street intersections were unsuccessful due to the rapid spread of the fire, but finally, successful demolition of three buildings was secured seven blocks from the point

International.

Fire fighters operating hose streams along side streets at the east and west of the fire attempted to slow its progress to give dynamite squads time to clear a firebreak ahead of the blaze. As may be seen at the upper right, tar coated metal roofs without parapets or fire walls quickly ignited, assisting the spread of flames. Firemen lacked ladders with which to fight these roof fires.

where the fire started, and the blaze was checked. Spread of the fire to the east was stopped at the Central Avenue parkway.

Results and Recommendations.

The loss was estimated at $2,500,000 to buildings and $1,000,000 to contents. Much of the property was not insured and since valuation figures are not available these loss estimates may be somewhat high.

Although martial law was not declared, 1000 U. S. soldiers patrolled the area after the fire to prevent looting. The army also set up a double row of tents sixteen blocks long and provided field kitchens to feed and shelter the thousands of homeless. Rebuilding in the burned area was started immediately.

In view of the fact that another large section of equally hazardous construction exists north of the fire area, it is recommended that frame buildings in this area be condemned and replaced with fire-resistive constructions within five years.

To improve fire protection it is recommended that the paid personnel of the fire department be increased to thirty men at salaries sufficient to insure tenure of service. Two hose wagons should be replaced with pumpers and an automatic aerial ladder provided. Larger water mains and more adequate hydrant service are also needed to prevent further conflagrations.

The 1939 Fire Loss.

Fire losses in the United States for the year 1939 were $274,943,000, according to the estimate of the National Board of Fire Underwriters. This figure supersedes the preliminary 1939 fire loss estimate published in the January, 1940, QUARTERLY. This represents an increase of $9,351,769, or 3.5 per cent, over the losses of 1938.

The following table gives the annual fire loss in the United States for the past sixty-five years.

Annual Fire Losses in the United States for Sixty-Five Years.

Estimates by National Board of Fire Underwriters.

Year	Property Loss	Year	Property Loss	Year	Property Loss
1875	$78,102,285	1897	$116,354,575	1919	$320,540,399
1876	64,630,600	1898	130,593,905	1920	447,886,677
1877	68,265,800	1899	153,597,830	1921	495,406,012
1878	64,315,900	1900	160,929,805	1922	506,541,001
1879	77,703,700	1901	165,817,810	1923	535,372,782
1880	74,643,400	1902	161,078,040	1924	549,062,124
1881	81,280,900	1903	145,302,155	1925	559,418,184
1882	84,505,024	1904	229,198,050	1926	561,980,751
1883	100,149,228	1905	165,221,650	1927	472,933,969
1884	110,008,611	1906	518,611,800	1928	464,607,102
1885	102,818,796	1907	215,084,709	1929	459,445,778
1886	104,924,750	1908	217,885,850	1930	501,980,624
1887	120,283,055	1909	188,705,150	1931	451,643,866
1888	110,885,665	1910	214,003,300	1932	400,859,554
1889	123,046,833	1911	217,004,575	1933	271,453,189
1890	108,993,792	1912	206,438,900	1934	271,197,296
1891	143,764,967	1913	203,763,550	1935	235,263,401
1892	151,516,098	1914	221,439,350	1936	266,659,449
1893	167,544,370	1915	172,033,200	1937	254,959,423
1894	140,006,484	1916	258,377,952	1938	265,591,231
1895	142,110,233	1917	289,535,050	1939	274,943,000
1896	118,737,420	1918	353,878,876		

NOTES—Previous to 1916 figures obtained from the records of the New York *Journal of Commerce*, deducting the Canadian losses. Subsequent years are based on returns to the Actuarial Bureau of the National Board of Fire Underwriters, adding 25% for unreported and uninsured losses. Since 1935, 30% has been added for unreported losses. The figure for 1939 is based on estimates made by the Actuarial Bureau.

U. S. Losses Higher for First Part of 1940.

Fire losses in the United States for the first five months of 1940 were $150,563,480. This is an increase of $8,869,254 over the loss for the same period of 1939. These figures are also the estimates of the National Board of Fire Underwriters.

	1937	1938	1939	1940
January	$25,069,895	$27,676,337	$27,615,316	$36,260,650
February	28,654,962	26,472,626	29,303,520	34,410,250
March	29,319,029	29,050,968	30,682,168	29,788,800
April	26,663,854	25,616,112	27,061,522	26,657,190
May	21,437,739	22,917,577	27,031,700	23,446,590
Total—5 months	$131,145,479	$131,733,620	$141,694,226	$150,563,480

Canadian Fire Losses, 1939.

Canadian fire losses for 1939 amounted to $24,632,509, according to statistics furnished by W. L. Clairmont, Dominion Fire Commissioner, Department of Insurance at Ottawa. This is a decrease of more than 5% under that for the year 1938. The number of fires reported in 1939 was 45,755, which is 1,651 more than were reported in 1938. Loss of life by fire during 1939 amounted to 263 lives, which is the same number as reported in 1938. However, 45 less children were burned to death in 1939, while 45 more men died by fire. Misuse of gasoline and other flammable liquids caused 53 of the total fire fatalities.

A Decade of Fire Losses in Canada.

Year	Property Loss	Year	Property Loss
1930	$46,109,875	1935	$23,221,521
1931	47,117,334	1936	21,549,484
1932	42,193,815	1937	22,746,058
1933	32,676,314	1938	25,899,180
1934	25,437,840	1939	24,632,509

Causes of Fires in Canada, 1939.

Causes Reported	No. of Fires	Property Loss
Smokers' carelessness	13,785	$2,135,069
Stoves, furnaces, boilers and smoke pipes	4,959	1,953,748
Defective and overheated chimneys and flues	4,175	1,702,202
Hot ashes, coals, open fires	2,742	328,806
Electrical wiring and appliances	2,622	1,371,211
Miscellaneous known causes	2,492	727,070
Sparks on roofs	1,421	432,929
Lightning—buildings rodded	16	10,492
Lightning—buildings not rodded	1,213	453,714
Matches	1,171	230,354
Lights, other than electric	1,141	209,042
Petroleum and its products	1,068	572,660
Exposure to adjacent building fires	905	969,232
Spontaneous ignition	398	629,292
Incendiarism	276	577,520
Motion picture film ignited	6	1,672
Unknown	7,365	12,327,496
Total	45,755	$24,632,509

Occupancy Record.

	1939		Ten Years 1930-1939	
	No. of Fires	Loss	No. of Fires	Loss
Dwellings (all classes)	32,186	$5,666,537	320,441	$98,127,095
Farm property (excluding dwellings)	3,455	2,872,328	41,781	33,814,552
Retail and wholesale stores	3,197	4,292,316	40,629	70,747,200
Manufacturing properties	1,039	3,788,360	8,931	52,306,759
Churches, schools, and institutions	512	2,187,866	5,387	16,555,773
Miscellaneous property	5,366	5,825,102	42,828	19,127,095
Total	45,755	$24,632,509	459,997	$291,391,604

Provincial Fire Record, 1939.

	No. Fires	Loss	Fires per 10,000 Population
Alberta	1,517	$1,148,364	19.2
British Columbia	3,397	1,705,610	44.0
Manitoba	1,046	800,300	14.4
New Brunswick	1,218	1,210,209	27.0
Nova Scotia	1,722	1,658,154	31.0
Ontario	14,927	7,922,402	39.8
Prince Edward Island	245	136,801	25.8
Quebec	20,745	9,333,500	64.5
Saskatchewan	938	717,169	9.9
Total	45,755	$24,632,509	40.6

Municipal Group Classification, 1939.

	Loss
Cities over 10,000 population	$7,861,816
Towns 5,000 to 10,000 population	828,156
Towns 1,000 to 5,000 population	1,701,882
Villages and rural districts	14,171,355
Total	$24,632,509

Braintree, Mass., Gas Plant Explosion.

Four men were killed and fifteen other persons were injured, nine seriously, when a gas explosion demolished a compressor building at the Old Colony Gas Company plant at East Braintree, Mass., while workmen were making repairs on the morning of April 9, 1940.

Description of Plant.

This plant consisted of a group of buildings and a 750,000 cubic foot gas holder. Water gas was formerly generated, but for the past ten years gas has been purchased from the Boston Consolidated Gas Company and the water gas equipment has been held in reserve. The territory served is rather large and gas delivered to the mains is compressed to 25 to 40 pounds per square inch.

"Compressor and Meter House Number 4," where the explosion occurred, was a one-story brick building 40 by 88 feet. The roof plank on steel framing; the floor non-combustible. The building contained two steam driven gas compressors and one gasoline engine driven gas compressor. The lighting fixtures were of the vaporproof type with switches outside the building.

Story of the Explosion.

On the morning of the explosion, three workmen, including the foreman, were sent into the building to make repairs on the steam end of one of the compressors. These men were experienced employees. None of the machinery in the building had been operated that day, the only compressor in operation being an electric driven compressor in another building. Just what happened

International.

Four men were killed and fifteen were injured in an explosion in the compressor building of the Old Colony Gas Company, East Braintree, Mass., on April 9, 1940. Firemen are shown directing streams on a 750,000 cubic foot gas holder, from which gas escaped and ignited following the blast.

will probably never be known, but at 9:41 A.M. a devastating explosion took place which completely demolished Compressor and Blower Building No. 4, and Compressor Building No. 3, which was thirty-five feet away, badly damaged the walls and roof of the boiler house and generator building twenty feet distant, broke all windows on the north side of the office building and storehouse two hundred feet away, and windows of the garage building, the roof of which was severely damaged. The explosion also ruptured the 750,000 cubic foot three-lift gas holder seventy-five feet away.

In the ruins of the explosion no burned material could be seen and there were no effects of fire except on the steel gas holder. It is possible that flying bricks punctured the holder, or the force of the explosion ruptured some seams. However, the most probable cause of escaping gas was the blowing out of the water seals. This explanation appears confirmed by an observer who stated that the flame came up the side of the holder from two distinct levels. The flames did not shoot outward from the side of the holder.

The escaping gas burned until the holder, which had been about three-quarters full, dropped to the empty position. The heat of the burning gas warped some of the holder structure, apparently doing considerable damage. Gas was also ignited in the Compressor House No. 3.

The policeman in the square about a block from the plant sounded the first alarm upon hearing the explosion, which is said to have blown him toward the fire alarm box. The fire department upon arrival found that there was very little that they could do, although a general alarm was sounded as a precautionary measure. Five hose lines were run and streams were directed on the gas holder to keep it cool. One workman died at the time of the fire and three others died before night. Of the fifteen other persons taken to the hospital, eight or nine were in a serious condition.

Property Damage.

It is estimated that property loss to the plant will run more than fifty per cent, or $217,500. Use and occupancy losses were estimated at $25,000. In addition there is some insured loss due to legal liability from the explosion which damaged buildings and broke windows within a considerable radius. The total damage appears to be over $250,000.

Four men were killed and fifteen were injured in an explosion in the compressor building of the Old Colony Gas Company, East Braintree, Mass., on April 9, 1940. Firemen are shown directing streams on a 750,000 cubic foot gas holder, from which gas escaped and ignited following the blast.

Llao Llao Hotel Fire, Argentina.

By G. W. Gill and O. A. Gray,
(Members N.F.P.A.).

To encourage the flow of tourists to the region of the Argentine Lakes, a part of which has been reserved as a National Park, the construction of a huge hotel was commenced in 1935 by the Argentine Forestry and Parks Commission. The hotel, completed in 1937, was built on the top of a small hill in the center of the Llao Llao Peninsula, near the Andes mountains and the Chilean boundary. The hotel took its name from this peninsula: it was about 120 feet above lake level. Bordering Lake Nahuel Huapi to the east, ran the only communication line with the outside world, a road to the nearest rail-head, Bariloche, some twenty miles away, 800 miles southwest of Buenos Aires by airline. The estimated cost of the hotel was about 3,000,000 Argentine pesos, or $1,250,000 United States money.

The Llao Llao hotel in the Argentine Lakes National Park, near Bariloche, Argentina, was opened in 1937. The exterior walls were largely of cypress logs and the roof was of wooden shingles.

In the early hours of October 26, 1939, fire broke out in the Hotel Llao Llao. The premises were almost entirely gutted within a few hours in spite of the efforts of the staff. Due to the fact that the season had not started, the hotel was empty except for the maintenance staff, and there was no loss of life. Had the fire taken place when the hotel was filled to capacity (250 guests), it seems certain that some loss of life would have occurred.

NOTE: Mr. G. W. Gill is Manager, Norwich Union Fire Insurance Society, Ltd., and Mr. O. A. Gray is Technical Adviser to the Association of Foreign Insurance Companies in Argentina.

Description of the Property.

The building measured some 330 feet long and 69 feet wide and consisted of two basements and four floors above grade. In order that the hotel might harmonize with its surroundings, soft wood timber from the neighboring forests was used to a large extent in its construction. This and the errors in the design, such as large areas without fire walls, large concealed spaces, wall fillings of sawdust and shavings, lack of standard automatic sprinkler protection, made it impossible to control the fire once it had started.

The hotel was surrounded by a large park, in which were located the chapel, garage, golf course and mole on Lake Nahuel Huapi. Owing to the isolated position of the hotel it had been found necessary to make it independent of daily supplies from Bariloche, and costly installations for making bread, aerated waters, ices and such, had been installed, as well as all modern labor saving devices. The building was occupied as follows:

SUB-BASEMENT—Heat, refrigeration and incinerator installations, barber shop, print shop and other small premises needed for the establishment.

BASEMENT—Kitchens, bakery, wine cellar, dining rooms, linen storage, servants' quarters, elevator pits.

GROUND FLOOR—Entrance porches, terraces, lounge, offices, ballroom, grill bar and guest rooms.

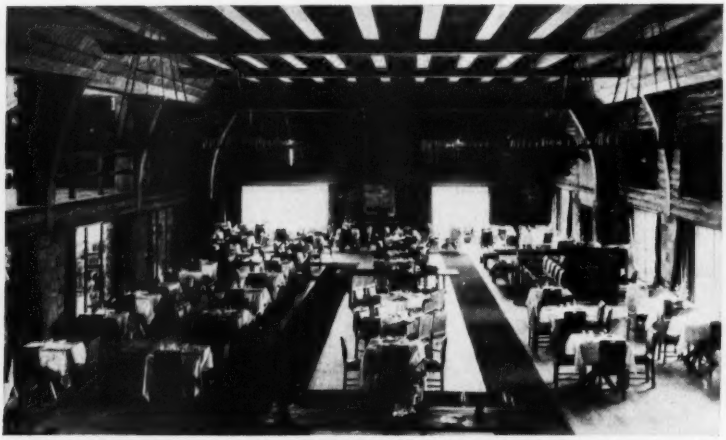
UPPER FLOORS—Guest rooms, lounges, storage rooms, with staff quarters on the fourth floor.

The foundations and outside walls of the basement levels were constructed of stone and brick with no combustible sheathing. The floor between the basements was of reinforced concrete, as was part of the ground floor. In these locations, columns and beams were of the same material. In addition, the structural frame of the eastern wing of the hotel was constructed of reinforced concrete, but the presence of the concrete had been disguised by entirely lining it with wood. This type of construction was carried out in this wing because of the kitchens. It was believed that fire, if it was to break out at all, would break out in or near the kitchens.

The large proportion of combustible material used in addition to the concrete would, however, neutralize the value of the concrete construction.

Outside walls were mostly of wood, 8-in. by 8-in. timbers being used and anchored in the brickwork. As an external facing, natural logs were placed horizontally to give a rustic appearance. In all, the trunks of 14,500 cypress trees were used and brought to the site on rafts. After a brief drying process, they were sawed and used. Sawdust and shavings were employed as insulation.

Internal partitions of 4-in. by 4-in. timber uprights were used, sheathed with boards. Floors, except in the east wing, were of wood, or tile on wood and steel girders. Steel members were covered with wood. Combustible fiber board insulating material was used with sawdust filling. Ceiling linings were



The principal dining room of Hotel Llao Llao illustrates the construction features employed. Interior finish was almost exclusively of wood. Automatic sprinkler protection was limited to a few heads under the roof.

wooden boards with felt insulation nailed to floor joists. Wall linings with the exception of stone around the fireplaces and chimneys were of tile or wood.

The roof was constructed of Chilean larch shingles on 2-in. by 3-in. wooden frame.

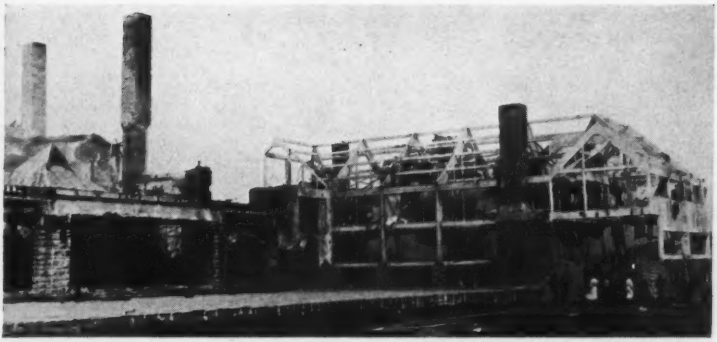
Heating was by ordinary low pressure steam radiators and open fireplaces. The electrical installation was entirely in conduits in walls and columns.

All of the furniture and most of the accessories were brought from Buenos Aires, a shipping distance of 1100 miles.

Fire Protection.

As it was doubtful whether the hotel would be insured, the technical adviser to the insurance companies was not consulted until the height of the 1937 tourist season. During an inspection at that time, the fire protection facilities were condemned and improvements were recommended. These modifications could only be considered after the season ended and when the fire broke out the recommendations were still being investigated.

The hotel was supplied with water by means of a 4-in. main from an open elevated tank of 130,000 gallons capacity some 600 yards away, upon a hill twenty feet higher than the roof. As the loss by friction was considerable, a 75 H.P. electric pump at 120 lbs. pressure was installed. This pump drew water from the lake. Since the tank and booster pump were used for irrigating the park and golf course, however, it was necessary to find the mechanics, and shut off the valves to the golf course in the event of a fire. This allowed pressure for the fire installations.



Following the fire of October 26, 1939, little remained of the hotel except for the stone and concrete foundations and the concrete framework of the kitchen wing. This concrete framework had been so well disguised by wooden sheathing that it proved to be valueless as a fire retardant.

The electric current for the pump was supplied by an overhead cable through the forest from a power station fifteen miles away, and could very easily be destroyed by falling trees or fire in the forest. Moreover, following the season the power station generally shut down after midnight and on Sunday afternoons.

Over the wooden shingle roof, open sprinklers had been installed, and under the roof a total of thirty-four sprinklers had been placed in two lines at right angles to the hotel, with the intention of dividing the eaves space into three sections with water curtains, though it was hard to understand what practical protection these would afford.

There were 560 automatic alarms installed throughout the hotel connected to a central indicator board. As there was no experienced electrician available and because frequent false alarms had caused protests from tourists the current was shut off for considerable periods, if not entirely.

Twenty standard 2½-in. standpipe connections were installed on 3-in. pipes from a 4-in. riser from the same water supply as the sprinklers. Sixty feet of 2½-in. linen hose was supplied for each connection, but was generally kept in a storeroom.

Fifty-two fire extinguishers were on the premises but were not charged, since the night watchman who was responsible for the fire appliances was evidently unable or unwilling to give proper care to the equipment.

Although the Government owned the hotel, it was leased to a private firm, which considered that the Government was responsible for the fire protection. The Government, on the other hand, had no control over the management of the hotel and did not supply trained men for fire protection.

Only two chimneys remained of the main portion of the Llao Llao hotel near Bariloche, Argentina, following the fire. In the background may be faintly seen several of the snow-capped mountain peaks which contributed to the scenic grandeur of the location.

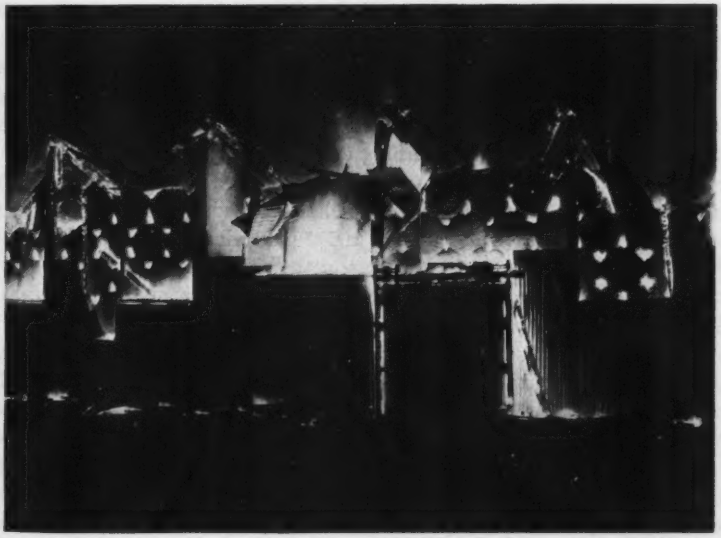
The fire apparently broke out about twenty minutes after midnight on October 26, 1939. The cause was not determined. At the time the only people in the hotel were the manager, his wife and child, and ten members of the staff. That something was wrong came to the attention of the manager's wife when a bedside light in her room went out and a smell of burning wood was noticed. Her husband traced the smoke to a room on the ground floor, which soon afterwards burst into flames. The alarm was given at once and with the aid of the staff and some laborers, who had been working on the premises, the fire was attacked with hose and fire extinguishers.

Owing to the combustible construction and the fact that the water did not reach the seat of the fire located in some of the hollow spaces in floors and walls, efforts to prevent the spread of the fire were unsuccessful. Aided by a strong wind, the fire spread with great rapidity throughout the building and it was reduced to ashes in some six hours despite the arrival of a detachment of soldiers from Bariloche.

The only salvage obtained was part of the furniture, which was removed from the building at the very start of the fire, the structure and contents of the second basement and part of the first basement. Otherwise, the building and its contents were totally destroyed. Some stonework, the chimneys and concrete structure of the east wing remained. The building loss was 78 per cent of the insured value and the contents losses were 62 per cent. This would make a loss of approximately $1,000,000 U. S. dollars on the building in addition to contents losses. No use and occupancy insurance was carried and as the hotel was completely booked for the coming season, this loss must have been very heavy.

New Zealand Newsprint Paper Fire.

A spectacular fire involving a large quantity of newsprint paper occurred at Addington, a suburb of Christchurch, New Zealand, on February 5, 1940. Newsprint paper in rolls is generally considered of relatively limited hazard since, due to the firmness of the rolls, it is not readily ignitable. Once ignited, however, it burns with some intensity, as may be seen by the accompanying illustration. The fact that this fire occurred in a corrugated iron on wood frame warehouse of comparatively light construction afforded fire protection engineers on the scene an opportunity to observe the manner in which the paper was consumed. One interesting feature noticed was the added intensity of the fire in each roll after the wooden core in the center of the roll was burned out, thus creating a draft through the roll.



The fire was discovered at about 8:45 P.M. when flames burst through the roof of the structure, and in less than two hours very little of the framework remained. The cause of the fire could not be determined. The work of the Christchurch Fire Brigade was considerably hampered by an inadequate water supply. The water had to be drafted from sumps by the pumpers and the quantity available was insufficient.

The information on which this report is based and the illustration were provided through the courtesy of Mr. J. W. Bolland, Secretary, Canterbury Fire & Accident Underwriters' Association, Christchurch, New Zealand. (Member N.F.P.A.)

The Natchez Dance Hall Holocaust.

Report by Mississippi State Rating Bureau,
(Member N.F.P.A.)

The utter disregard for ordinary fire preventive measures in a dance hall in Natchez, Mississippi, changed what was to be a gala, rhythm evening on Tuesday, April 23 last, into a grim catastrophe that wiped out the lives of 207 negroes. The hazards disregarded included (1) the use of highly combustible material for decorating purposes, (2) inadequate exits and (3) the overcrowding of places of assembly.

In the 1850's Natchez was a flourishing cotton growing center of 18,500. Now, it is a very quiet and very old river town of 16,000. Sixty per cent of its population is negro. Lately, Natchez has become famous for its ante bellum homes, which thousands of tourists visit each year. More recently, the town has become famous for the dance hall tragedy which occurred there on the evening of April 23.

On that evening, Walter Barnes, a Vicksburg, Mississippi, negro, was bringing his Chicago swing band to the Rhythm Club in Natchez for a one-night stand. Tickets were selling for fifty cents apiece and the cream of the Natchez negro population was turning out to pay its respects to a successful negro from the home state. Some came to mingle with society, listen to the music and depart early. Most came to dance and depart late. The ticket-taker in the lobby of the building took in 577 paid admissions, and 150 passes. Also in the dance hall were 14 members of the orchestra and five attendants, bringing the total to 746. At eleven P.M. probably a small number had departed.

Then with almost lightning speed, the dance hall became a blazing inferno. So swiftly did the flames spread that the merrymakers were caught entirely unawares. At 11:15 the fire department received a first alarm by telephone. Shortly thereafter, the fire was brought under control and extinguished. It was believed that all occupants of the building had escaped until members of the fire department went inside the smouldering ruins. There, victims by the score were piled one on top of the other, their clothing burned, their bodies charred. With but a few exceptions, all were dead. Many of those who showed some spark of life died en route to the hospital.

Construction of the Building.

The building had served two purposes before it was converted into a dance hall by the members of the Rhythm Club. At one time it had been a garage; previous to that it is said that it had also been a church. The building was 38 feet wide and 120 feet long.

Pictures, Inc.

The morning after the fire. Note corrugated sheet iron construction of the building. Removal of the bodies of 207 negroes necessitated tearing a hole through the rear left of the building. Many of the negroes seen loitering about building lost either friends or relatives, or both, during the fire of the preceding evening. It was estimated that each negro family in Natchez suffered the loss of some friend or relative.

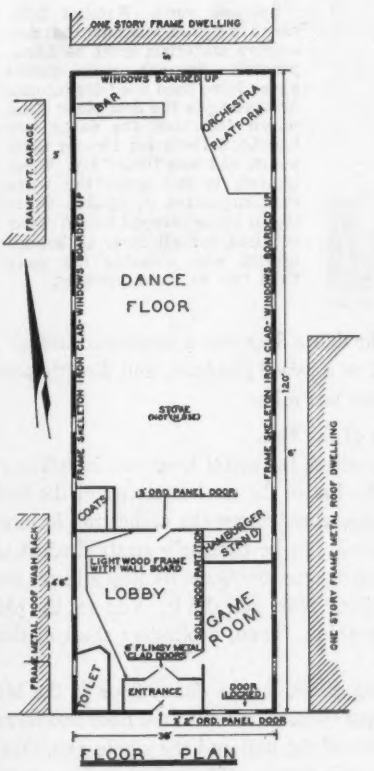
There were 24 window openings in the building, of which two in the game room (front right) were iron barred. A third window in the game room had ordinary glass, while all other window openings in the building were covered over by shutters to obstruct the view of the curious and to make the hall usable in the winter time. All of the shutters opened to the inside and were about four feet above the floor level. Some of the shutters were held secure by sliding latches. The majority of them were nailed shut. Very few of those trapped were able to make an escape through the window openings.

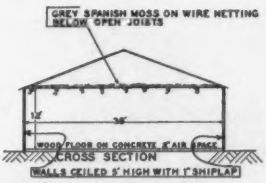
The sides of the building were constructed of two by four wooden studs covered with corrugated metal. Inside, one-inch ship-lap lined the building for a distance of five feet above the floor. The lining prevented those trapped from breaking through the side walls. The corrugated metal construction turned the building into an oven when the fire began to spread.

There were two entrances, but each was located in the front and one was padlocked from the outside. To all intents and purposes, then, there was but one exit available to those trapped in the building when the fire broke out. Although the single available door opened to the inside, it is not believed that this increased the loss of life, for there was no accumulation of bodies in the

Pictures, Inc.

The rear of the dance floor. Orchestra platform is at the right, bar is at the left. Note that some strands of Spanish moss are still hanging from the wires under the ceiling joists. Note also, ship-lap boarding that lined building to a height of five feet above the floor. This is the portion of the building where the negroes died. Window openings were nailed shut at time of the fire.




GREY SPANISH MOSS ON WIRE NETTING BELOW OPEN JOISTS
36'
WOOD FLOOR ON CONCRETE 8' AIR SPACE
CROSS SECTION
WALLS CEILED 5' HIGH WITH 1" SHIPLAP

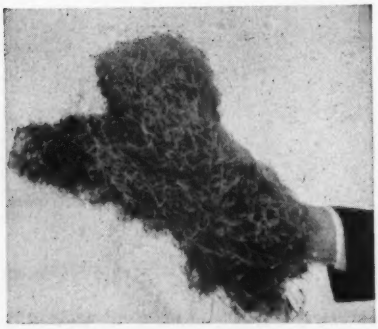
Layout of the Natchez, Mississippi, Rhythm Club. Fire that wiped out the lives of 207 negroes started somewhere near the hamburger stand and spread rapidly to the rear of the dance floor where the bar and orchestra platform were located. Merrymakers caught behind the advancing wall of flames were either suffocated, baked by the intense heat, or trampled to death. Note single entrance to the dance floor, boarded windows, and "check-valve" exit system of lobby. Spanish moss, which served as interior decoration, was supported by wire netting below open joists. Building was once a church and later a garage. No part of the building was completely burned, nor did any part of it collapse.

lobby. Without a doubt, however, the door did act as a check valve for those who were trying to get out.

The single door opened into a narrow entrance way about six feet deep, at the end of which were a pair of double swinging doors, which also opened to the inside and into a lobby. The lobby was a room about 24 by 27 feet. The dance floor itself was reached from the lobby through a single door mounted on a flimsy partition and which opened to the outside. The hazard created by the doors which opened into the lobby can readily be seen.

The dance floor gave the impression of a long cave. The entire ceiling was covered with gray Spanish moss supported by wires strung in both directions. The moss was everywhere from six inches to a foot in thickness and was intended to conceal the roof space. The draped moss added to the cave-like atmosphere of the dance floor, for it was stalactite-like in appearance. Not unlike stalactites, it was estimated that the moss had hung in the building for two or three years as decorative material. It was tinder dry.

are still hanging from the wires under the ceiling joists. Note also, snip-lap boarding that lined building to a height of five feet above the floor. This is the portion of the building where the negroes died. Window openings were nailed shut at time of the fire.



Spanish moss. Natchez holocaust is a grim reminder that decorative materials must be flameproofed. Spanish moss should never have been used for interior decorating in the first place. That which decorated the dance hall had been there for two or three years, and was tinder dry. When ignited, it fell from the wires that supported it, ignited clothing of those trapped below. Time required for all moss to become ignited was probably not more than two or three minutes.

To the right of the entrance to the dance floor was a hamburger stand. In the far right corner was the orchestra on a raised platform, and directly across from the orchestra in the far left corner was a bar.

Progress of the Fire.

At eleven o'clock when the fire started, the social hour was in full swing. A large crowd had gathered around the bar in the far left corner of the building while another large group was congregated about the orchestra platform.

Although the cause of the fire could not be definitely established, it was believed that a lighted cigarette or match somehow found its way into the moss decorations. Someone was heard saying, "Now you did it. You set the place on fire." For a moment, there was nothing. Then, a blinding sheet of flame near the hamburger stand.

Panic seized the negroes standing about on the dance floor as the blaze spread toward them. As the moss began to burn, it fell to the floor and formed a wall of fire between those in the rear of the hall and the single exit. Many tried to reach the exit through the burning moss. Their clothes were ignited immediately. Their cries of horror and pain probably stopped others from doing likewise.

Meanwhile, the falling moss extended its wall of flame from the front to the rear of the dance hall. The merrymakers found themselves being driven to the rear wall of the building where, ultimately, they were to be either suffocated or trampled to death. Few were able to beat through the nailed shutters of the windows with chairs. Those who did escape in such a manner received horrifying burns, and most did not live. The majority of those trapped at the rear end of the building were either suffocated or baked by the superheated temperature of the corrugated iron.

Once the fire department had arrived, it was a comparatively simple matter to stop the blaze. No part of the building burned completely nor did any part of the building collapse. In order to remove the seared remains of those 198 negroes trapped and cremated, it was necessary to tear away a portion of

the sheet iron at the rear of the building. Of the few who were still found alive, nine died from the shock which they had undergone. Many of the victims were comparatively young — sixteen and seventeen years of age.

Conclusions.

> "The decorations of theatres and assembly halls shall be of fire-resistive or non-flammable materials. Fabrics and papers used for such purpose shall be treated with an effective flame-proofing material. Stage settings made of combustible materials shall likewise be treated with flame-proofing materials.
>
> "Note. Paper and cloth decorative materials should be kept to a minimum in places of public assembly, since such flimsy materials increase the hazard of the kindling and spread of fire."

The above is a verbatim quotation from Sec. 25 of the N.F.P.A.'s Building Exits Code. Spanish moss is certainly a decorative material and certainly a flimsy material, so flimsy that it should never have been used for a decorative material in the first place. It should have at least been flame-proofed.

For the second and third conclusions, it is possible to quote from the same N.F.P.A. publication, but such quotations should not be necessary. The need for exits at both front and rear of the building is obvious. The cost of making it obvious, however, has been 207 lives, and indescribable grief and anguish for the entire negro population of Natchez.

Lastly, the building was tremendously overcrowded. So overcrowded that it seems incredible that as many escaped as did.

Bridge Fire at Kansas City, Kansas.

Report by Kansas Inspection Bureau,
(Member N.F.P.A.).

A large steel bridge and viaduct which spans the Kaw River to connect Kansas City with the suburban district of Argentine was severely damaged by a fire of uncertain origin which occurred on April 16, 1940. Known as the Twelfth Street Bridge, the structure was the most important of four bridges serving the Argentine district.

The structure was composed of five steel spans having a total length, not including the approaches, of over a thousand feet and an over-all width of sixty feet. The three central spans were double, making two independent bridges for six hundred feet, one side carrying northbound traffic, the other side southbound. The steel trusses were carried on masonry piers and the bridge was incombustible except for the deck. This surface was paved with wood blocks laid on a three-inch wood plank floor. The floor was supported on six by six-inch timbers, which were laid across steel girders. All wood members, including the pavement, were creosote-treated and a thin coating of asphalt was spread over the entire deck surface. The south span of the bridge extended over the main line and switch tracks of the Santa Fé Railroad, the next two spans were over the river, and the two north spans were over ground gradually inclining from the river to the north approach.

The bridge carried two lines of streets car tracks, which furnished the only service of this kind to Argentine. There were two sixteen-inch water mains supported by the bridge that served that part of the city located south of the river. Other water service to this part of the city is provided by two twelve-inch and one ten-inch mains carried by other bridges. Telephone cables serving about seventeen hundred telephones in the Argentine district were carried on this bridge, as were electric light and power high voltage lines.

Story of the Fire.

A street car operator first detected the fire when his car passed over the bridge. He gave the alarm, which was received at the fire station at 10:35 A.M. The first company, responding from a distance of about two-thirds of a mile, gave a second alarm upon arrival. Two companies responded to the first alarm and three to the second.

A sixteen-mile wind was blowing from the northeast, which caused the fire to spread quite rapidly in a southerly direction from the second span on the north where it originated. Three hydrants on large mains were located within

Firemen are shown attacking from the north bank of the Kaw River, the fire which destroyed the Twelfth Street Bridge at Kansas City, Kans. They were unable to effectively reach the fire directly over the water and were able to save only the end spans.

a thousand feet of each end of the bridge. It was not possible to fight the fire from the surface level of the bridge as the fire was mostly on the underside. There was no fireboat or other means available to fight the fire directly over the water, and little progress could be made through the use of single hose lines from the low ground near the water, because of the height of the bridge and the strong wind. The turret pipe on a truck operating from the ground under the north end was more effective.

The two-way radio used by both the police and fire department proved to be very useful in maintaining contact between parts of the fire department operating on opposite sides of the river. It was also of great value after the fire, during the twenty-four hours that telephones in Argentine were out of service, as it provided the sole means for transmitting fire alarms to the department. Kansas City has no municipal fire alarm system and is dependent upon the public telephone system for the transmission of alarms.

The heat produced by the fire was intense, seriously exposing the steel trusses. The wind protected the east side to some extent, but the west side was subjected to high temperatures. At about noon the center span on the west side collapsed and fell into the water. A sixteen-inch water main went down with it and had to be shut off, but this did not interfere with the operation of

The result of the fire which fed on the combustible deck of the bridge. This view, looking south, shows the collapsed west side of the bridge. When these spans fell they carried with them a water main and telephone and electric cables.

the fire department. About fifteen minutes later, the west side of the next span to the south side fell into the river. With the collapse of these spans, telephone and electric cables were broken, cutting off these services to the Argentine district. The fire was finally stopped at the last span on each end of the bridge and little damage, if any, was done to these two spans. The three intervening spans were a total loss or severely damaged and it will probably be necessary to rebuild them. The loss, including the damage to utilities, is estimated at about $320,000.

The cause of the fire is not known. The railroad tracks which pass under the south end of the bridge are approximately five hundred feet from the point where the fire was first seen. There are those who hold the opinion that the fire was caused by a carelessly discarded cigarette. There was an open space between the east and west sections of the bridge where refuse might have lodged in sufficient quantity to have been ignited by a cigarette or match.

Fire Record of Motor Craft.

The problem of pleasure and commercial motor craft fires has had the constant attention of the N.F.P.A. Marine Section since 1926, when as the Marine Committee it developed standards governing marine fire hazards. These standards have been frequently revised. The latest edition entitled, "Fire Protection Regulations for Motor Craft, Pleasure and Commercial," was published in 1939.

The files of the N.F.P.A. Department of Fire Record contain reports of 167 typical fires which have occurred in motor craft within the past decade. The following tables and reports serve to draw attention to the penalties that may be expected to follow failure to observe the precautions recommended in the N.F.P.A. motor craft standards. With very few exceptions the fires included in this record might have been avoided if the provisions of these standards had been observed.

While many of the reports upon which this fire record is based were inadequate in detail, enough information was provided to permit some conclusion as to the cause of each fire. In the absence of detailed information which might make possible a better understanding of the causes of several of the explosions, the language of the original reports has been retained. For example, it is reported that sixteen fires "occurred while taking on fuel." This merely indicates the circumstances of the fire. The true cause would probably be found to be accumulation of gasoline vapor due to improper ventilation or faulty tank installation.

Table I shows that the outstanding hazard of the motor boat is its fuel, gasoline, and that "backfire of engine" is the leading single cause of fire. Galley stoves were responsible for eleven of the fires included in this record. In seven cases the stoves exploded, and in the remainder, the stove was responsible for the ignition of surrounding woodwork or other flammable material. In all but two cases the explosions occurred in gasoline stoves. The use of gasoline stoves on boats is contrary to the N.F.P.A. standards for motor craft. One galley stove explosion was the result of liquefied petroleum gas escaping from the supply cylinder. Had the tank been located above decks as specified by the N.F.P.A. motor craft standards, this explosion probably would not have occurred.

From Table II it will be seen that 90 persons lost their lives as a result of the fires in this record. This includes persons who were drowned in attempts

Table I, Causes of Motor Boat Fires.

1930-1940.

Cause	At marina or dock	At sea or away from dock	Total	%
Explosions				
1. Backfire of engine	8	16	24	14.3
2. Gasoline in bilges	10	7	17	10.2
3. While fueling with gasoline	15	1	16	9.8
4. Leak in gasoline line	1	5	6	3.5
5. Galley stove (gasoline)	1	4	5	3.0
6. Galley stove (propane)	2	0	2	1.2
7. Fueling from a can while engine was in operation	0	4	4	2.4
8. Gasoline fuel tank exploded	2	0	2	1.2
9. Outboard motor exploded	0	2	2	1.2
10. Gasoline windlass exploded	0	1	1	.6
11. Fuel oil fumes under deck	1	0	1	.6
12. Static electricity ignited gasoline fumes	1	0	1	.6
13. Soldering "empty" gasoline tank	1	0	1	.6
14. Miscellaneous gasoline explosions	19	27	46	27.5
Galley stove (no explosion)	1	3	4	2.3
Electrical causes	1	1	2	1.2
Miscellaneous known causes	3	0	3	1.8
Unknown causes	6	9	15	9.0
No data	4	11	15	9.0
Total	76	91	167	100

Table II, Losses of Life and Personal Injury.

	Men	Women	Children	Total
Drowned escaping fire	21	5	5	31
Trapped aboard burning boat	8	2	4	14
Fatal burns or injuries	25	8	1	34
No data	9	2	0	11
Total fatalities	63	17	10	90
Non-fatal burns or injuries	129	28	20	177

to avoid being burned to death. It should be noted that the fatalities resulted from 43 fires, or an average of more than two lives lost in each fatal fire. In addition, for every fatality resulting from motor boat fires, two persons suffered non-fatal injuries.

Comparatively few of the fires included in this record were reported as extinguished with first aid fire equipment. However, it is probable that many small fires on boats are extinguished by means of first aid appliances and that

International.

A minute before this picture was taken, Captain Clifton Luber dived from the burning 69-foot yacht "Araemo" with his clothing aflame and died the next day in a hospital. The upper structure of the yacht was blown away by the explosion, which occurred in Mark's shipyard, Baltimore, on June 16, 1940.

the losses are so small that the fires are not reported. It is only when a fire does material damage or results in personal injury or death that it attracts attention and is reported. In some of the fires in this record, extinguishers were effective in checking the fire until it could be extinguished by streams from a fire or patrol boat or from land apparatus.

In reviewing the reports of motor boat fires, one is struck by the great speed with which these fires spread. Within a few moments, most of the fires reported were beyond the control of the small capacity fire extinguishers usually carried on motor boats. It is apparent from many of the reports that fire extinguishers were inaccessible due to the sudden flash of fire. This was particularly true when the extinguishers were located in the engine compartment where the fire broke out, or so close thereto as to make it impossible to reach them. The N.F.P.A. standards require at least two extinguishers at accessible separate locations on all power boats. Unfortunately many locations which may have appeared accessible before the fire could not be reached under fire conditions.

In twenty fires, water-borne fire equipment such as fireboats or patrol boats was used either independently or in conjunction with other fire equipment. A large number of the fires occurred within or comparatively short dis-

Harold S. Walker.

The harbor patrol boat at Marblehead, Mass., credited with controlling several serious yacht fires in that important yachting center, is shown applying a 1½-inch hose stream to burning underbrush on a harbor island.

tances from yacht clubs, marinas, and public landings. Several high speed fire fighting or patrols boats equipped with extinguishers or with fire pumps and hose are in service at yachting centers and have proved their value in extinguishing boat fires or in rescuing persons from burning boats. Some of these vessels are maintained by yacht clubs for the protection of members and guests, while others are operated by municipal fire and police departments. The large municipal fireboat found in the larger shipping centers is usually strategically stationed for the protection of high value waterfront property and steamships. These large fireboats have rarely been available to furnish prompt protection to yacht basins, and in most cases lack the speed essential to effectively combat motor craft fires.

Table III, Fire Protection Used.

	At marina or dock	At sea or away from dock	Total
First aid appliances	13	34	47
Land fire apparatus	22	5	27
Water-borne fire apparatus*	7	13	20
None	10	27	37
No data	27	23	50

*Includes all types of water craft equipped for fire fighting.

Typical Motor Craft Fires.

Presented below are summaries of typical fires in motor craft to illustrate the types of losses that are occurring with appalling repetition. Such fires should indicate to yachtsmen and others the dangers which may attend motorboating when fire protection standards are ignored, as well as point out specific hazards which should be guarded against.

MARBLEHEAD, MASS., AUGUST 15, 1930. The value of a harbor patrol boat equipped for fire fighting at yacht basins was illustrated by a fire which damaged the 55-foot cabin cruiser, *King Robin*. The yacht was anchored some 200 yards off shore among numerous other yachts, when an explosion occurred while the craft was taking on fuel from a gasoline tender. Damage to the many other yachts anchored near by was prevented by the prompt response of the harbor patrol boat. The fire was extinguished with foam equipment. It is believed that some of the fuel from the feed line may have overflowed and become ignited by the engine of the tender.

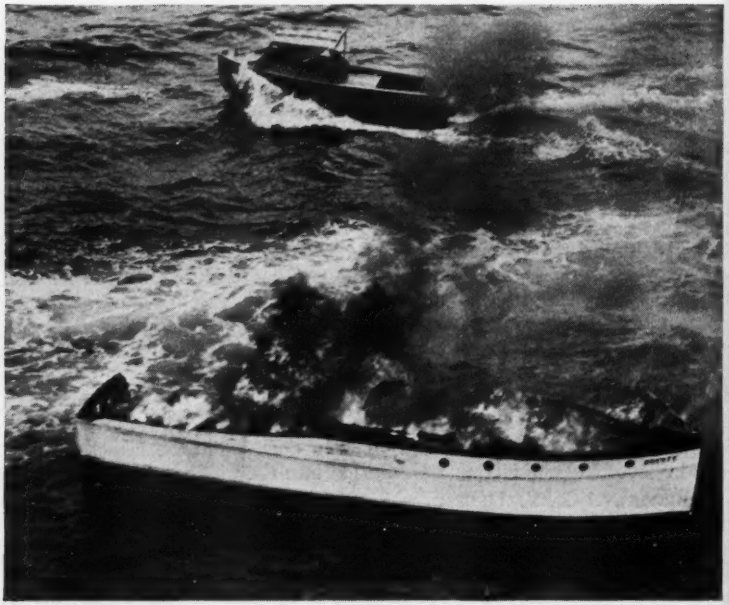
ITHACA, N. Y., MAY 24, 1930. Seven persons were injured when the 60-foot gasoline yacht *Playmate* blew up at a dock while the vessel was being fueled. Several of the victims were hurled into the water by the explosion.

BROOKLYN, N. Y., DECEMBER 3, 1930. Accidents which may result from the careless handling of gasoline on board motor craft are exemplified by a fire which took the life of a young yachtsman on the auxiliary sloop *Dorothy B.* The yachtsman had picked up a can of gasoline preparatory to going ashore. He stumbled, spilling the contents of the can over the hot engine. The flames ignited his clothing and he was fatally burned before other persons succeeded in extinguishing them with blankets.

MIAMI BEACH, FLA., DECEMBER 14, 1930. Three persons lost their lives and more than a hundred others were rescued as a flash fire swept the *Eureka I*, an 87-foot "see-bottom" excursion boat off Bug Light, fifteen miles from Miami Beach. The flash occurred in the engine room immediately after a generator was put into operation. There were three 80-gallon tanks of gasoline and one 80-gallon tank of kerosene located in the engine room. These tanks were provided with fill-hole covers having the usual breather hole in each cap. It is believed that the engine room became filled with vapors from the breather holes and that these vapors were ignited by sparks at the generator. Several hand extinguishers and fifteen or twenty carbon tetrachloride grenades were used in a futile effort to control the fire. It is obvious that the arrangement of the gasoline tanks was faulty.

SAN FRANCISCO, CALIF., APRIL, 1931. The three-masted auxiliary schooner yacht *Sinaloa* sank after an explosion had blown out one-third of its sides, torn away its decks and shattered its bulkheads. The caretaker of the yacht escaped with minor injuries. Marine surveyors who inspected the vessel after it was raised, believe that a leakage of gasoline had allowed fumes to accumulate in the bilges. These were ignited by a spark from the generators which were operating at the time.

GREENPORT, N. Y., JULY 26, 1931. A woman was fatally burned and five other persons were injured in an explosion which shattered the 36-foot cabin cruiser *Chevalmer II* shortly after 150 gallons of high-test gasoline had been taken aboard. Fumes in the engine compartment and bilges were ignited when



International.

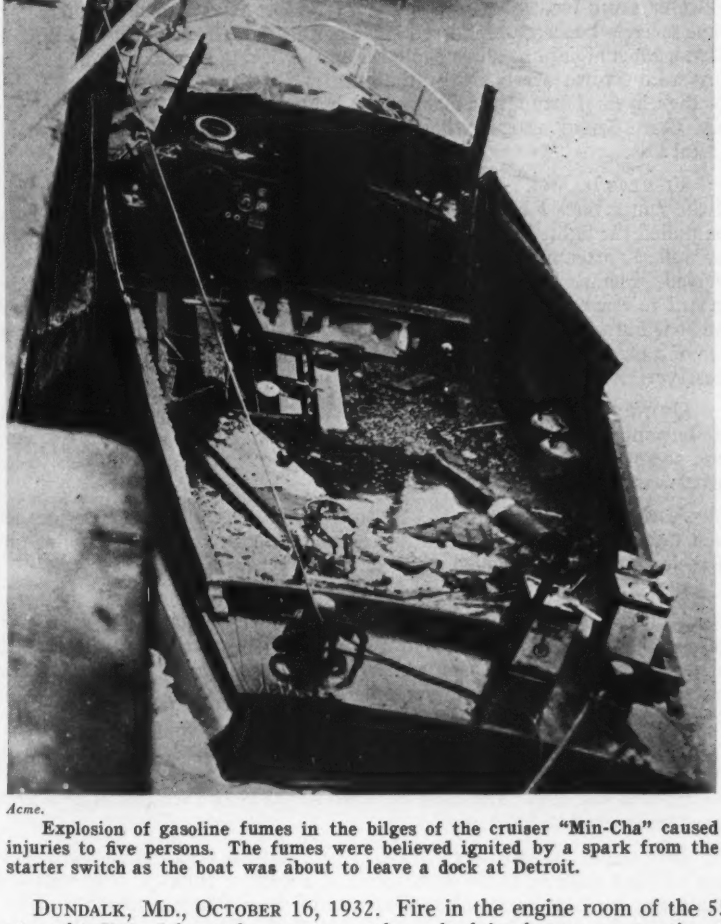
Six persons were rescued from this burning cabin cruiser by a fishing vessel. In fires similar to this, the prompt arrival of fire fighting equipment may spell the difference between a small loss and tragedy.

the owner pressed the self-starter button. The fire spread with great rapidity, but the local fire department was able to extinguish it.

MAMARONECK, N. Y., AUGUST 22, 1931. Two men narrowly escaped death when an explosion and fire destroyed an 18-foot motor launch in Long Island Sound. The explosion occurred when one of the men tried to pour gasoline from a tin container into the fuel tank on the boat. A rolling sea caused gasoline to spill on the hot exhaust pipe. An explosion occurred which enveloped the after end of the craft in flames. Suffering burns, the two men were about to jump into the sea when they were picked up by a passing boat.

CHELSEA, MASS., OCTOBER 5, 1931. Two men jumped into the harbor from their 32-foot cabin cruiser when the engine backfired and ignited gasoline fumes in the bilges. The fire was extinguished by a fireboat after the cruiser had been severely damaged.

CHESAPEAKE BAY, MD., OCTOBER 16, 1932. Six persons including two women and a boy were forced to leap into the bay to escape a fire and explosion which shattered their 36-foot cabin cruiser. The fire, believed due to a leak in the gasoline line, was attacked with fire extinguishers, but the burning gasoline spread to inaccessible areas. Realizing that the fire was beyond control, the passengers donned life belts and jumped overboard. Within a few moments the gasoline tank blew up and the boat sank. Occupants were later picked up by fishermen.



Acme.

Explosion of gasoline fumes in the bilges of the cruiser "Min-Cha" caused injuries to five persons. The fumes were believed ignited by a spark from the starter switch as the boat was about to leave a dock at Detroit.

DUNDALK, MD., OCTOBER 16, 1932. Fire in the engine room of the 55-foot yacht *Roja I* burned one man and resulted in damage amounting to $50,000. A short circuit in the engine room ignited gasoline or oil leakage when the captain switched on the lights there. Finding he could not check the fire with an extinguisher, he called the fire department.

SAN PEDRO, CALIF., MARCH 4, 1933. One man was killed and another critically burned in a gasoline explosion which destroyed a motor tug. In this case, four gasoline tanks, aggregating 2000 gallons capacity, were completely below the deck housing with no outside vents. Filling was by hose through an open hatch and the displaced vapors accumulated in the hold and engine room. After the tanks had been filled and capped, the engineer proceeded to fill eight 55-gallon steel drums, also below decks. While thus engaged, a flash occurred from an undetermined source and the ship was blown to pieces.

OFF LONG ISLAND, N. Y., APRIL 23, 1933. Seventeen men and women, some severely burned, were forced into the waters of Great South Bay, off Long Island, when a gasoline stove exploded on the fishing boat *Zangara*. Two persons were thrown overboard by the blast and the others were forced to leap for their lives. Fortunately many other boats were near by and no lives were lost. Coast Guard cutters extinguished the fire, but the fishing boat was almost a total loss.

FISHERS ISLAND, N. Y., JULY 17, 1933. Flames spread through the cabin of the motor boat *Firenze II*, cruising in Block Island Sound, when a heavy sea pulled the lighted kerosene stove from its fastenings and hurled it against the wall. In attempting to extinguish the fire, one man was overcome, but was revived. Flames blocked all attempts of the three men and three women aboard to reach life preservers. Nevertheless, they were forced to jump. As the boat burned to the water's edge and sank, the flames attracted the attention of a passing aviator, who radioed for assistance and dropped his only life preserver. An Army tug rescued the party.

QUINCY, MASS., JUNE 3, 1934. Lacking a fireboat and unable to reach the burning cabin cruiser *Juanita* with a hose stream from the shore, firemen took to row boats and carried their hose lines out to the craft. The 43-foot vessel was burned to the water's edge.

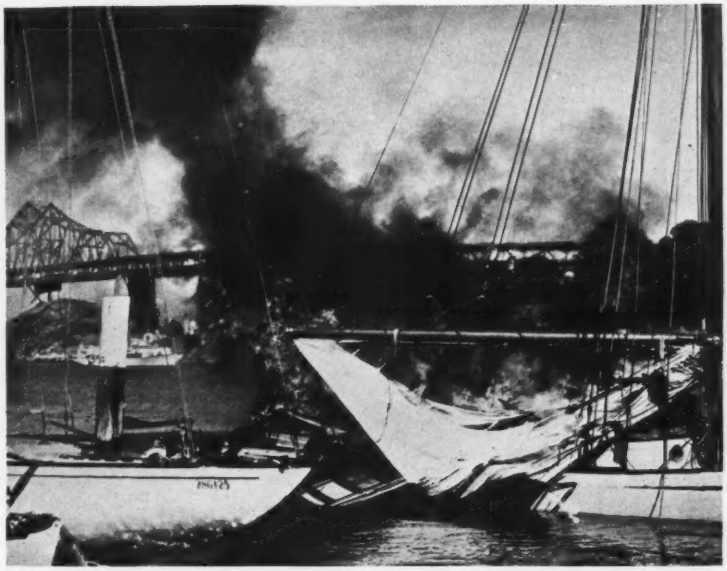
ANNAPOLIS, MD., JULY 14, 1934. Typical of many similar serious and even fatal accidents, a man and his son were injured when the gasoline tank of their motor boat exploded while being soldered.

BOSTON, MASS., AUGUST 26, 1934. A motor boat took fire in the harbor shortly after refueling from a gasoline barge. Seeing the flames burst from the stern of the boat, the police boat *Watchman*, which was close by, attacked the flames with fire extinguishers. After extinguishing the fire the patrol boat towed the damaged craft to a pier, where the members of a fishing party were disembarked.

PRINCE ALBERT, SASK., NOVEMBER 8, 1934. That hazards exist in the operation of outboard motor boats is demonstrated by an explosion that caused the death of one man. The blast occurred as the victim was refueling his outboard motor on Lac La Range.

DODSON, ORE., JANUARY 23, 1935. Fire starting on a motor boat moored to a building resulted in the destruction of a salmon cannery. Two men were measuring the boat for a cabin when one of them struck a match to light a cigar. Gasoline fumes were ignited with a flash. The men escaped, but due to the remote location and lack of protection, the plant was a total loss.

MARBLEHEAD, MASS., AUGUST 8, 1935. Two persons were burned and hundreds of boats were endangered by a gasoline explosion on the 40-foot auxiliary sloop *Tarpon*. As breakfast was being prepared on the galley stove, the *Tarpon* tied up alongside a gasoline lighter and started to have its tanks refueled. A sudden explosion caused flames to leap from the forward part of the boat. The lighter's crew, fearing that the 500-gallon gasoline cargo might explode, cast off its lines. The harbor patrol boat successfully extinguished the fire after a stubborn battle.



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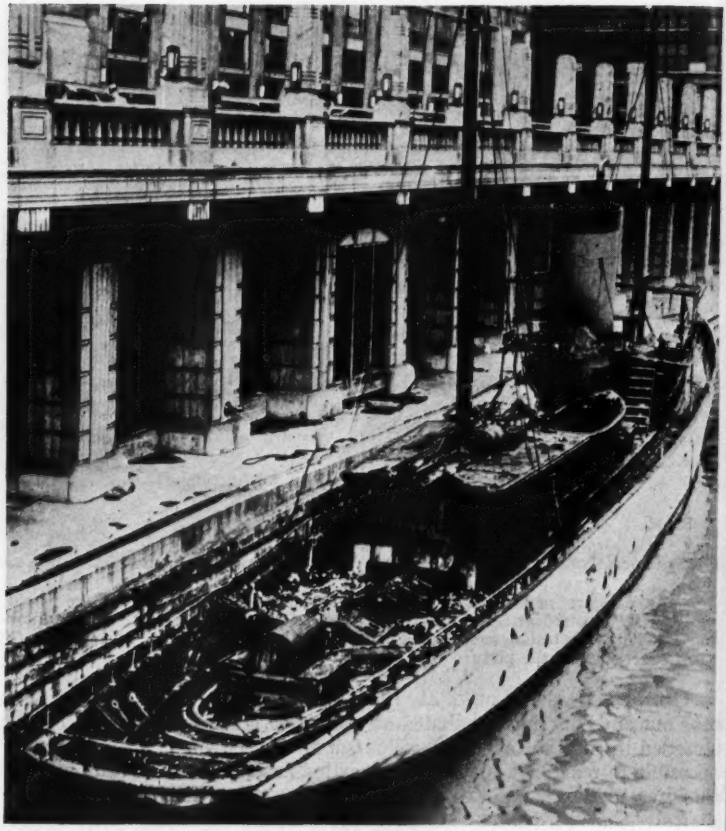
The dangers of fire at a marina are shown by this fire on the yacht, "Fulton G," moored at San Fra. .co's Golden Gate Exposition. The fire, following a gasoline explosion, endangered other boats moored near by. The "Fulton G" sank shortly after the picture was taken.

QUINCY, MASS., AUGUST 21, 1935. Following an engine backfire, flames broke out and continued unabated on the motor launch *Fifty-fifty*. The crew succeeded in shutting off the gasoline supply to the engine. Flames made it impossible to reach five of the six fire extinguishers aboard. Fortunately tugboats drew alongside and extinguished the fire.

STAMFORD, CONN., OCTOBER 26, 1935. When the galley stove exploded and set their 30-foot cabin cruiser afire, three yachtsmen were forced to don lifebelts and jump into Long Island Sound, where they floated for an hour before a passing steamship picked them up.

OFF YARMOUTH, N. S., MAY 8, 1936. A fisherman and his son were severely burned when a can of gasoline exploded on their motor boat. They were twenty-five miles at sea. Both were showered with exploding liquid when the father carried the gasoline into the cabin in which a stove was burning. A third member of the crew treated their burns, hauled in the nets and made a six-hour run to port, where the victims received medical attention.

MIAMI, FLA., JULY 1, 1936. The importance of adequate precautions during and after refueling is shown by an explosion and fire which seriously burned six persons on the 40-foot cabin cruiser *Cymba*. Some gasoline had been spilled in filling the tanks, and ventilators were opened and the bilges pumped out before the engine was started. Nevertheless, when the engine started, it backfired and an explosion followed, blowing out the sides of the



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The yacht "Doris" was damaged by fire on May 3, 1934, as it lay moored in the Chicago River. It is believed that a passer-by on the drive above tossed a cigarette on the canvas awning of the boat, causing the fire which swept the superstructure.

cabin. For a time two men were trapped inside the cabin, but they were finally dragged out to the dock. Firemen fought the flames for half an hour, nearly filling the craft with water before the fire was out.

HALIFAX, N. S., AUGUST 26, 1936. An explosion followed by fire caused burns to eleven persons aboard the auxiliary schooner *Kinrara,* while it was taking on gasoline at an oil dock. A flexible hose fitted with a valve at the nozzle was connected to a standard steel supply drum on the dock and the gasoline was discharged through a funnel into a three-quarter inch feed pipe. There was no ventilating pipe from the tank to carry off vapors, nor was there any connection, other than that provided by the funnel, between the tank filling opening and the deck opening. Consequently, while the tank was being filled

gasoline vapors collected in concealed spaces throughout the hull. When the engine was started an instant explosion occurred, followed by fire. Those aboard were either blown from the boat or forced to jump into the water. All were rescued.

MANASQUAM, N. J., JULY 9, 1939. While the cabin cruiser *Alida* was thirty miles at sea, an explosion in the engine compartment endangered six persons. The blast followed a break in the fuel line when gasoline fumes were ignited by the engine. After shutting off the flow of gasoline, the captain put out the fire with a fire exinguisher and the *Alida* was towed to shore.

MARBLEHEAD, MASS., MAY 22, 1940. Two men were injured, one fatally, when propane gas from the galley range on the yacht *Trim-Too* exploded, wrecking the boat and blowing the roof off of the large sprinklered boat shed where the yacht was stored. The victims were preparing the boat for the yachting season when the blast occurred. It appears that in some manner propane escaped from the tanks and an accumulation of the gas in the bilges was ignited when an attempt was made to light the stove. Investigation following the fire showed both tanks to be tight and in satisfactory condition. One tank was empty and the other was almost full. Search in the wreckage showed one of five shut-off valves of the stove assembly in open position, but it is not known how long the valve may have been open prior to the explosion. Ignition may have been from a match or smoking material, or it may have been due to an attempt to light the stove, which the workmen used for boiling water and making coffee. There may have been a leak at some connection, as the force of the explosion indicated that considerable gas had accumulated in the bilge. Paint fumes in the galley and cabin of the boat were very strong and would probably have offset the distinctive warning odor of the gas.

BAYSHORE, LONG ISLAND, N. Y., MAY 25, 1940. Mistaking a jug of gasoline for a similar one containing water, a woman poured the fuel into a coffee pot and put it on a coal stove to boil. A few minutes later the gasoline exploded, setting fire to the cabin cruiser *Fannie*. The woman and her grandfather were trapped in the burning cabin and fatally burned.

Fires in Which There Was Loss of Life.

Second Quarter, 1940.

Reports of one hundred and fourteen fatal fires in the United States and Canada have been received by the N.F.P.A. Department of Fire Record since the publication of the April, 1940, QUARTERLY. Four hundred and ninety persons died as a result of these fires. During this period the following fires were reported which resulted in the death of five or more persons each.

MARCH 7, 1940, MOUNT PLEASANT, TENN. A woman and four of her children were burned to death when fire of undetermined origin destroyed their three-room home. (L-06106.)

MARCH 15, 1940, TORONTO, ONT., CANADA. Three men and two women lost their lives as the result of a fire which severely damaged the Avonmore Hotel. In all cases, suffocation or smoke poisoning was the immediate cause of death, two of the victims dying in the hospital a few days after the fire. Although the cause of the fire could not be positively determined, it was believed to have started in a wooden bucket which was used as a receptacle for dumping the contents of ash trays. The building was of brick-joist construction and the main section was three stories in height. There was an open stairway, centrally located, connecting all floors and it was up this stairway that the fire spread with great rapidity from the ground floor. (H-43651.)

MARCH 16, 1940, SHIRLEY, ARK. Eight members of a family were burned to death and two others seriously injured when fire destroyed their farm home. The mother and six of her ten children were trapped in a bedroom and died together. Her 17-year-old son, after escaping from the flames by jumping from a window, died when he rushed back into the house in an effort to rescue the others. The cause of the fire could not be determined. (L-06107.)

MARCH 16, 1940, NEFFS, OHIO. Seventy-two men died as the result of a coal mine explosion. It is reported that a coal dust explosion and fire followed the ignition of a charge of black pellet powder. (L-06108.)

MARCH 18, 1940, PORT ALFRED, P. Q., CANADA. Five small children died in a night fire which swept their apartment home. Although the source of the fire could not be accurately determined, it was believed due to electrical causes. The children were asleep on the third floor of the frame building when the fire broke out. The eldest, ten years old, escaped, but perished after reëntering the building. A maid also managed to reach the ground. The fire spread so rapidly and produced so much smoke that firemen were unable to enter through upper windows. (L-06109.)

APRIL 1, 1940, SEATTLE, WASH. Four children and a woman pilot were burned to death when an airplane fell 500 feet into a pile of sawdust and burst into flames. (L-06110.)

Loss of Life by Fire, April-June, 1940.*

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Occupancy	No. Fires	Men	Women	Children	Total
Aircraft	4	18	2	4	24
Amusement places**	1	104	103	0	207
Apartments, hotels, lodgings, tenements, etc.	15	12	8	10	30
Barns and stables	1	0	0	1	1
Boats and ships (except tank vessels)	4	5	0	0	5
Dwellings—rural	27	15	10	30	55
Dwellings—urban	30	12	22	16	50
Forest and brush fires	2	2	0	0	2
Gas works	1	4	0	0	4
Hospitals and institutions	2	1	1	0	2
Lumber yards	3	4	0	0	4
Manufacturing occupancies	3	3	0	0	3
Mercantile occupancies	1	0	0	1	1
Mining property	1	72	0	0	72
Motor vehicles (except tank trucks)	5	4	3	0	7
Oil and gas wells	1	1	0	0	1
Oil refineries and bulk distributing plants	3	7	0	0	7
Out-of-door fires	3	2	0	1	3
Response to alarms	2	2	0	0	2
Theatres	1	1	0	0	1
Other known buildings	4	9	0	0	9
Totals	114	278	149	63	490

*This table is made up from those reports received by the Department of Fire Record between March 16, 1940, and June 20, 1940. A few of the fires included herein occurred prior to March 16, but were not reported until subsequent to that date.

**Reports stated that the 207 victims of the Natchez, Miss., dance hall fire of April 23, 1940, were about equally divided between men and women. For the purpose of these tables we have assumed the division to have been 104 men and 103 women.

APRIL 2, 1940, PORT ARTHUR, ONT., CANADA. Fire of undetermined origin brought death to six persons, including a woman and four children, when a house was destroyed on the outskirts of this town. The bodies of the victims were found in a hallway not far from the door and it was apparent that they had been overcome by smoke when only a few steps from safety. (L-06111.)

APRIL 23, 1940, NATCHEZ, MISS. Two hundred and seven negroes lost their lives when fire swept through a dance hall. Because there was but one exit and all windows were boarded up, only a few of the dancers were able to escape from the building. All but nine of the victims were trapped in the building; nine died subsequently from burns and smoke. (For details see page 70.) (H-43740.)

A report has been received that about a hundred persons, including sixty-seven children, died in a fire which destroyed the town hall at Sandona, Colombia. The report gives no details other than that the fire occurred during a local anniversaty celebration on May 6, 1940, and was caused by an electrical short circuit. This fire is not included in the tables. (H-43764.)

Causes of Loss of Life, April-June, 1940.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Cause of Fatality	Men	Women	Children	Total
Aircraft fires	18	2	4	24
Asphyxiation (smoke and gas suffocation)	9	7	7	23
Children alone in house	0	0	7	7
Children playing with matches	0	0	1	1
Clothing ignited:				
Bonfires, burning rubbish, etc.	3	0	0	3
Candles, lamps and torches	0	1	1	2
Furnaces, stoves and heaters	0	4	0	4
Smoking and matches	0	1	0	1
Smoking in bed	0	1	0	1
Entering a burning building	2	1	1	4
Escaping fire; jumped, fell or drowned	4	0	0	4
Explosions:				
Chemicals	1	0	0	1
Liquefied petroleum gases	1	0	0	1
Manufactured and natural gases	5	1	0	6
Miscellaneous and unknown	0	1	1	2
Fire fighting—firemen	3	0	0	3
Fire fighting—civilians	2	1	0	3
Flammable liquids and vapors:				
Gasoline and similar liquids:				
Used for cleaning purposes	2	1	1	4
Used to kindle fire	0	1	4	5
Miscellaneous	3	0	0	3
Kerosene, range oil, and fuel oil:				
Stoves, lamps, and torches	0	3	2	5
Used to kindle fire	3	1	11	15
Oil furnaces	0	1	0	1
Miscellaneous	2	0	0	2
Paint, varnish, removers, thinners, etc.	1	1	0	2
Petroleum production and storage	7	0	0	7
Indirect causes (overexertion, exposure, etc.)	2	0	1	3
Mine fires and explosions	72	0	0	72
Motor vehicle fires (except tank trucks)	2	3	0	5
Response to alarms	2	0	0	2
Trapped in burning buildings	133	118	22	273
No data	1	0	0	1
Totals	278	149	63	490

Typical Fatal Fires.

Airplane Fire.

APRIL 16, 1940, HIGGANUM, CONN. Two men were burned to death when their plane crashed and burst into flames. Two other passengers fought their way from the burning plane with multiple burns and injuries. (L-06112.)

Children Alone in House.

MARCH 27, 1940, ONION LAKE, SASK., CANADA. Four children between the ages of four and six, left alone while their parents were at a dance, were burned to death in a fire which completely destroyed a rural home. The parents returned to find the building a smouldering ruin, with the four bodies lying in the ashes. (L-06113.)

Clothing Ignited

APRIL 1, 1940, HORTON, KANS. An aged man was burned to death in a field near his farm home when his clothing became ignited as he was burning corn stalks. (L-06114.)

APRIL 3, 1940, BLUE RAPIDS, KANS. An elderly farmer was fatally burned when his clothing took fire while he was assisting his son in burning rubbish. (L-06115.)

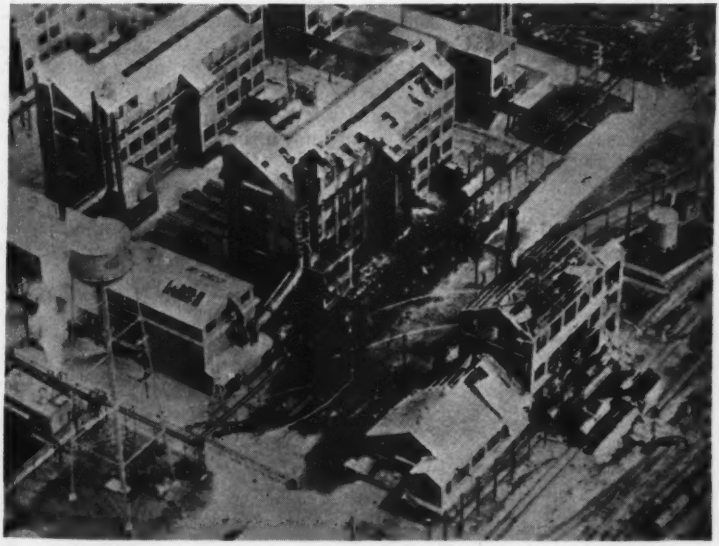
APRIL 22, 1940, WORCESTER, MASS. A woman was fatally burned when a match set fire to her nightgown. Alone in the house, she managed to extinguish the flames, but was so severely burned that she died the following day in a hospital. (L-06116.)

APRIL 29, 1940, NATICK, MASS. A woman died of burns received when her clothing was ignited by a stove. She was cleaning her kitchen walls when her dress came in contact with the hot stove and was ignited. (L-06117.)

Flammable Liquids and Gases.

MARCH 1, 1940, EATON, OHIO. A man died of burns received in an explosion which occurred while he and his wife were cleaning a room with gasoline. The woman was also critically burned. Their home and near-by outbuildings were destroyed by the fire which followed the explosion. (L-06118.)

MARCH 11, 1940, NORTH BERGEN, N. J. A blind man, his wife, son, and a guest were burned to death in a fire which destroyed a two-story frame



Acme.

An air view of the ethyl gasoline blending plant at Baton Rouge, La., where three men were killed and several others injured by an explosion and fire on March 19, 1940. The cause of the blast had not been reported. (H-43763.)

dwelling. A passing motorist discovered the fire at about 4:30 in the morning. When firemen arrived, the entire first floor was in flames. The Chief of the fire department reported that apparently a copper tube leading from a five-gallon tank to the kitchen range had broken and sprayed kerosene or range oil over the stove, which had been left burning low. One of the victims was found at the foot of the stairs, while the others died on the second floor. (L-06119.)

MARCH 21, 1940, PRYOR, OKLA. Three small children were killed and their mother critically burned in a fire which destroyed their two-room frame home. The mother said the fire resulted after she poured kerosene on live coals in the stove. (L-06120.)

MARCH 22, 1940, EAST HARTFORD, CONN. One man was killed and eight others injured by a gasoline explosion in an airplane factory. The explosion occurred in an engine testing room and apparently resulted from gasoline leakage which was ignited either by an engine backfire or by a spark from an electric drill. (H-43761.)

APRIL 15, 1940, NEW YORK, N. Y. A woman died from the effects of an explosion of cyclopropane, which had been administered to her as an anesthetic during a minor operation. Static electricity is believed to have caused the explosion that ruptured the patient's trachea and bronchi. (L-06121.)

MAY 3, 1940, PORT WASHINGTON, N. Y. Two workmen and their employer were killed and another man was injured by an explosion and fire which wrecked a petroleum products distributing plant. The explosion occurred while workmen were cleaning a 45,000 gallon gasoline compartment of a 260,000-gallon tank. Other compartments of the tank contained kerosene, gasoline, and fuel oil, none of which were affected by the blast. One of the men was working in the empty gasoline compartment, removing sludge with a wooden trowel and bucket. He wore a mask connected by a hose line to a compression pump outside and worked by the light of an electric extension lamp. The source of the ignition is not known, but the explosion may have been caused by the breaking of the lamp bulb. (H-43762.)

Response to Alarms.

APRIL 6, 1940, LAKEWOOD, N. J. A volunteer fireman was killed and eleven other members of the department were injured when their fire truck overturned on the way to a fire. (L-06122.)

IT WASN'T THE SPRINKLER'S FAULT

This $200,000 plant was totally destroyed by fire...because human failure *destroyed the sprinkler protection.*

...that this plant burned

When fire broke out, the sprinkler equipment functioned perfectly...

But the watchman, intending to prevent water damage, closed two shut-off valves ...before the fire was out, and without summoning the fire department. The blaze quickly regained headway... and by the time the fire department finally was summoned, it was too late.

The moral is obvious: a sprinkler system, no matter how perfect the mechanical equipment, cannot overcome the ability of human carelessness, neglect, intent or stupidity to destroy its effectiveness.

This hazard of human failure is most effectively eliminated through Central Station Electrical Supervision. Had this sprinkler system been so supervised, the fire department would have been summoned *automatically* as soon as the first head opened. Firemen would have been on hand...probably in time to prevent the premature closing of the valves...certainly in time to open them and to help the sprinkler fight the fire before it was beyond control.

Not only does A.D.T. Central Station Supervision assure maximum protection from the sprinkler system—it may also result in substantial savings, by making it possible to revise other protection measures that are more costly but less effective. Write for descriptive booklets and further information.

A. D. T. SPRINKLER SUPERVISORY AND WATERFLOW ALARM SERVICE

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Pigs are NOT always Pigs

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Today there is the same confusion in the minds of some buyers of internal safety valves for tank trucks. Some are satisfied to install any valve called a safety valve, regardless of whether it is safe or not.

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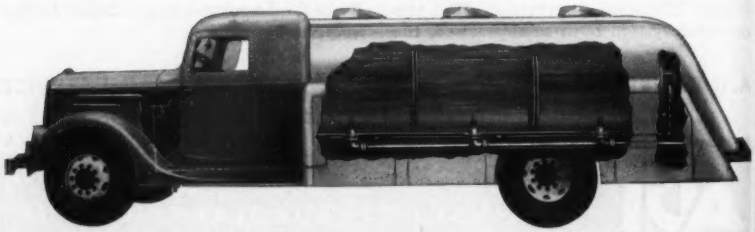

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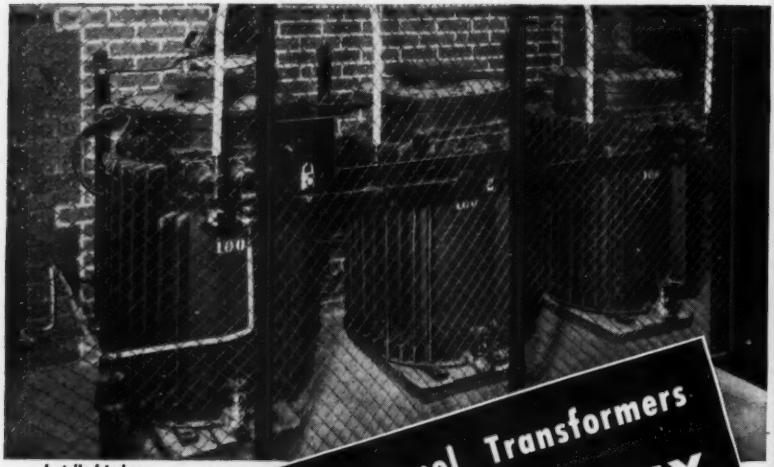

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The elevated tank shown here has a capacity of 100,000 gallons. It is 150 ft. to the bottom and is used exclusively for sprinkler service at a plant in Fernandina, Fla. If you need fire protection, write our nearest office for estimating costs and information.

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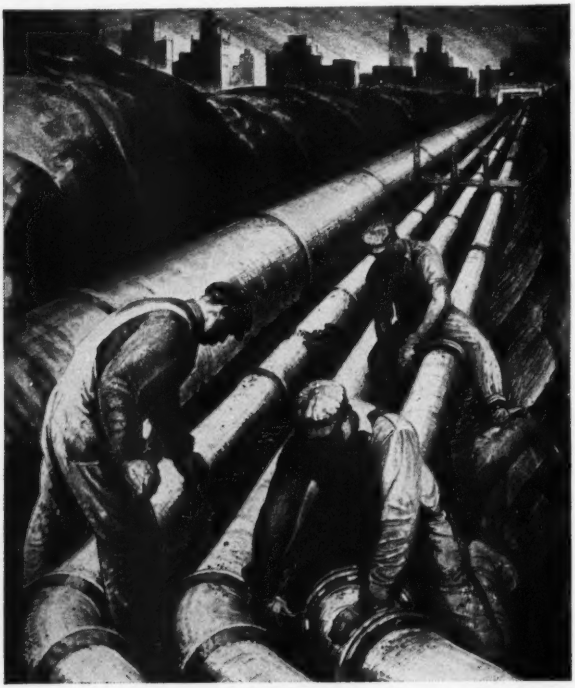

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NEW HOFFMAN DRY CLEANING UNIT SETS NEW STANDARDS OF SAFETY

While we are at all times interested in promoting greater safety in the use of the equipment we sell to the dry cleaning industry we are especially proud of this new development. Here for the first time is a petroleum solvent dry cleaning unit which has been granted listing by the Underwriters' Laboratories, Inc., under their Reexamination Service.

Such listing of course assures fire authorities and insurance rate-making bureaus that 140-F units will be built to specified standards and will be properly inspected.

USES 140° FLASH PETROLEUM SOLVENT

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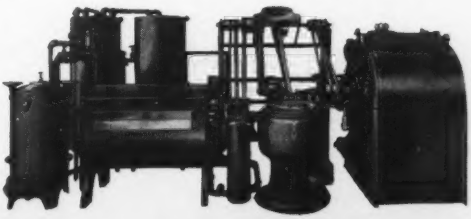

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This raging oil-gasoline fire was put out in 5 seconds with only 8 gallons of Rockwood WATERFOG.

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